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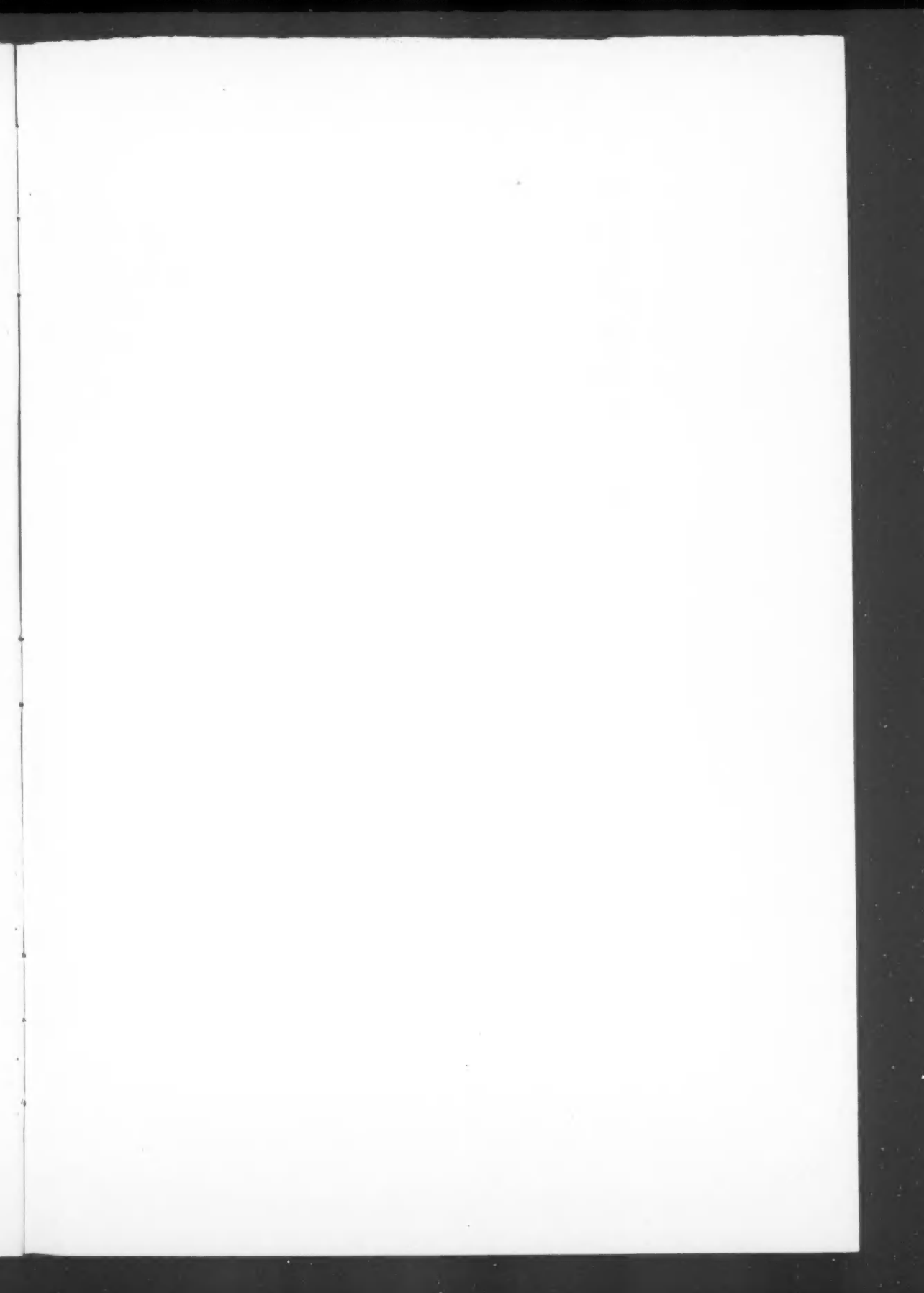
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NUMBER 1

BREEDING BEHAVIOR OF JAEGERS AND OWLS NEAR BARROW, ALASKA

By FRANK A. PITELKA, P. QUENTIN TOMICH, and GEORGE W. TREICHEL

On the arctic coast in 1952, near Barrow, Alaska, Pomarine Jaegers (*Stercorarius pomarinus*) and Snowy Owls (*Nyctea scandiaca*) nested at the time of an upswing in numbers of the cyclic brown lemming, *Lemmus sibiricus*. In 1953, when lemmings were at peak abundance, these two important predators again nested, the jaeger in much higher density than in 1952, and in addition a third predator was common, the Short-eared Owl (*Asio flammeus*). A considerable amount of information on the breeding behavior of these species was obtained by us in those two years, and it is the purpose of this paper to report observations that add to the existing knowledge concerning them.

The breeding of the Pomarine Jaeger, Snowy Owl, and Short-eared Owl near Barrow (latitude 71° N.) as well as elsewhere on the coastal plain bordering the Arctic Ocean in America and Eurasia is correlated with numbers of the brown lemming. In the higher interior country of the arctic and at more southern latitudes, the two owl species depend also on other microtines. But on the lowlands close to the Arctic Ocean it may be said that any significant amount of breeding in a population sense appears to depend on the brown lemming. This is particularly true for the Pomarine Jaeger. Those aspects of the ecological relations of these avian predators having to do with their responses to lemmings as prey are dealt with in another paper (Pitelka, Tomich, and Treichel, 1955). In that paper data on relative abundance near Barrow in 1949-54, on breeding densities and nesting success in 1952-53, and on predation are given. This information will be referred to here only insofar as it relates directly to aspects of breeding behavior considered in this paper.

The numbers of nests found, many of them revisited a number of times, were as follows:

	1952	1953
Pomarine Jaeger	30+	80+
Snowy Owl	3	7
Short-eared Owl	0	28

Field work was underway from May 29 to September 12 in 1952, and from May 17 to August 24 in 1953. It should be emphasized, however, that what we offer here are notes on species still deserving intensive study, and our observations were obtained mainly in the course of censusing of bird populations on various areas and while other field work on birds and mammals was underway. In the choice and organization of observations worth reporting, we have been guided by the general works of Bent (1921, 1938), Witherby *et al.* (1940, 1941), Salomonsen (1951), and Dementiev *et al.* (1951), as well as by a number of original references.

Variation in plumage of Pomarine Jaegers is such that often the members of a given pair, trio, or even quartet can be distinguished in the field. This is made possible not only by differences between dark and light phases and intermediates between them, but also by a quantitative color dimorphism between sexes. Use of these characters is facilitated also by sexual dimorphism in size, the female jaegers averaging about

850 grams, the males about 650. In addition, subadult individuals are distinguished by incompletely developed central rectrices as well as other characters (see discussion in Pitelka *et al.*, 1955). Hence, it is possible in this jaeger to deal with behavior in the field in a more specific way than in most other species without artificial marking, and these circumstances made possible some of the observations summarized beyond.

POMARINE JAEGER

Near Barrow, the Pomarine Jaeger is in general the most numerous of the three jaeger species (Bailey, 1948:234). It occurs from late May to early September, although in certain years it may arrive in early May or remain into late September. In lemming years, jaegers appear in large numbers when lemmings are exposed at the time of the spring melt-off of snow, in late May or early June. Numbers then fall off as breeding gets started.

Habitat.—As a breeding species, the Pomarine Jaeger frequents coastal flats near the Arctic Ocean, in areas of small lakes and meandering rivers (Dementiev *et al.*, 1951:387). On the generally flat terrain of the Barrow area, breeding pairs may settle almost anywhere, but they settle in greatest density where marshy flats or poorly drained lowlands are most extensive. This is the habitat of their chief prey, the brown lemming. As Dementiev (*loc. cit.*) brings out, Pomarine Jaegers are not parasitic while breeding.

The nest is placed on slightly raised ground, as on a low shelf at the border of an extensive marsh or on the low ridge inclosing a low-center polygon. Occasionally the nest is on a level with the surrounding ground. A hollow is formed, perhaps merely as the result of the heavy bird settling on the soft moist ground that already offers some sort of a depression. Likewise, some nests with plant materials surrounding them or in their bowls seem to be thus provided only because of the chance presence of this material nearby. We have not observed jaegers deliberately forming a bowl or carrying nesting material.

Non-breeding jaegers wander widely over the tundra and over the ocean, along the shore or out some distance, using ice floes as rests. They are usually in small groups, but may occur singly or occasionally in fairly large, loose flocks of as many as 50 or 60 individuals. In summers of non-breeding, as 1951 and 1954 near Barrow, their occurrence is irregular and usually brief.

Breeding schedule.—The breeding cycle requires 10 or 11 weeks and breeding begun in mid-June, if successful, is not completed until the last week of August. For the population as a whole, the breeding season of 1953 was 10 to 14 days ahead of that of 1952. This is correlated with the fact that snow cover persisted late in 1952, and the first jaegers were not seen until June 9, whereas in 1953, jaegers were first seen on May 25.

In 1952, nesting began about June 20, on which date the first nest, with one egg, was found. All other nests were started within the next five days. First newly hatched young were found on July 17, and by the 20th, almost all nests contained young. In 1953, eggs were laid chiefly in the period from June 16 to 19, although some were probably laid earlier. Hatching records obtained later indicated that some were laid as early as June 10 or 11. In the main, young hatched in the period from July 10 to 15, but one hatching egg was reported on July 6.

The incubation period of this jaeger is not known. Our efforts to determine it were not completely successful for any one nest, but for several the error in estimate was no more than one day. From three such records the incubation period was determined as 27 or 28 days. In the light of data reported for the smaller species *parasiticus* (Witherby

et al., 1941:124), this estimate is reasonable, and in any event more closely determined incubation periods of *pomarinus* will probably be found to vary over several days.

In 1953, additional nests were started later than June 19, as evidenced by the following observations: Copulation was observed as late as June 23, and the nest of this pair, with two eggs, was found on June 29. A new territory was established on June 22 in an area visited daily, and the nest with two eggs was discovered on July 8. Finally, a nest already containing two eggs on June 18 was found destroyed on June 24; the same pair started a second nest which contained one egg on July 2 and only one after that date. Thus, on a population basis, breeding was less synchronized in 1953 than in 1952.

Young are able to leave the nest after the second day and usually do so by the fourth, wandering in the vicinity of the nest site. They are fairly easy to locate until after the first week. By that time, they move fast, hide well, and are no longer necessarily near a marked nest site. Birds about one week old enter small ponds freely and swim rapidly. Young begin to fly when they are five to six weeks old. First young were seen on the wing in 1952 on August 25, in 1953 on August 13. They are attended by parents for at least a week more. Feeding of young by adults continues after the former are able to hunt for themselves. This period of semi-independence could not be determined exactly, but it is safe to state that it lasts at least a week. The repeated observation in 1952 of only one adult attending any one young bird suggests that toward the end of the period of fledgling dependence, only one adult feeds any given young, but this point also requires further study in the field.

Adults share in incubation and in the care of young, as previous observers have reported. Young are fed largely, if not exclusively, on morsels of meat torn from lemmings (*Lemmus*). Such pieces were regurgitated by some of the young handled during banding.

Clutch size.—In 1952, all nests found contained two eggs. In 1953, a fair number contained only one egg, perhaps five to ten per cent, but no definite data were gathered on this point. Although Bent (1921:9) states that clutches may consist of "two or three . . . , usually the former," there appears to be no basis for any statement or implication that three eggs may be laid by one bird. Witherby *et al.* (1941) advance their statements more cautiously, but credit the Parasitic Jaeger (*Stercorarius parasiticus*) with even four eggs per clutch, "very rarely." The fact is that specimens of both sexes of breeding *S. pomarinus* collected by us showed two distinct, bilaterally placed brood patches, 3x6 cm. in size, each large enough to accommodate one egg, and it seems that these jaegers must regularly incubate no more than two eggs. We note that Salomonsen (1951), in his treatment of the jaegers, credits none of them with more than two eggs per clutch in spite of the writings of earlier compilers. Dementiev *et al.* (1951:388) likewise point out there is no evidence of clutches larger than two.

In view of the chronic enthusiasms of old-school oölogists, as well as carelessness of some collectors with data, should not records for clutches in excess of two be checked thoroughly? In part, the notion that jaegers may lay more than two eggs may be traced to early writers such as Kumlien (1879:95), who, in other connections, made some fantastic observations (see, for example, comments of Salomonsen, 1951:261). There is a possibility, of course, that extra eggs may be laid by a second female, as indeed is suggested by Witherby *et al.* (1941:124) for the Great Skua (*Stercorarius skua*). This we are inclined to doubt for the Pomarine Jaeger because the species is so strongly territorial and any intruder is repulsed so promptly by either or both sexes that it is difficult to see how any intruding female would be tolerated long enough to lay an egg! It should be remembered that both members of a pair remain on the territory con-

stantly. These comments are made even though we have, ourselves, found a five-egg nest of the Red Phalarope (*Phalaropus fulicarius*) and know that the H-shaped incubation patch of the male is formed to accommodate no more than four. In this species the loose organization of the breeding population actually allows for the occasion of a second female entering one nest. However, in the case of our five-egg nest, after a few days the extra egg was found a few inches outside the nest, which then was still active.

Territoriality.—Pomarine Jaegers are strongly territorial, and in this respect they resemble the Long-tailed Jaeger, *Stercorarius longicaudus* (Manniche, 1910:175). They occupy territories any time from the last week of May through the first two weeks of June, one to two weeks before eggs are laid. Both members of a pair act in defense of a territory, and such behavior continues through the period that young are dependent on their parents. Foraging is normally confined to the territory, throughout the nesting cycle, and adults defend their territories into August with almost as much vigor as earlier.

Once a pair is established and nesting is begun, the birds are generally silent. The fact of an occupied territory is advertised merely by the presence of the occupants cruising slowly over the area or standing erectly on the ground or some slight promontory if such is available. If there is a threat of intrusion, a jaeger at rest and settled on the ground may merely rise and erect itself. It may also call or it may raise its wings in a threat display as it calls. Or it may take wing, flying toward the threatened approaching intruder; if the jaeger is on wing, cruising slowly, it will increase its speed and fly directly toward the intruder, usually calling. The typical call is a harsh, gull-like *yowk, yowk, yowk*, variable in pitch and tempo, becoming a series of high-pitched, sharp screams when the jaeger is excited. If an intruder enters the territory, the jaeger, or usually both members of a pair, call persistently and swoop down or dive over the intruder, wheeling back over the territory rapidly, and then, with accelerated flight and another sequence of screaming calls, again swoop over the intruder. The intruder may be struck with the dropped feet as the jaeger passes over. This ultimate in aggressive behavior of the Pomarine Jaeger is addressed to humans, to vehicles, to owls grounded or flying slowly over a territory, or on occasion to larger birds on the ground, such as Brant (*Branta nigricans*). If the intruders are other jaegers or gulls, those merely moving across an area in long distance flights accelerate their speed and fly on silently. Territorial action then consists merely of the chase and calls. But if the occupant jaeger is already more or less excited, or if the intruder is reluctant to leave or is contentious, the jaeger may swoop over or toward such casual intruders and double back to repeat this. Such behavior is commonplace between competing neighbors with much yelling, swooping, and wheeling over the contested area by all four members of the competing pairs.

The aggression among jaegers is chiefly bluff, and rarely does it lead to bodily clash. But it definitely may among birds occupying compressed territories, as was observed in one area in 1953 when the activity centers of three neighboring territories were no more than 400 to 500 feet apart (see west side of plot 1 in fig. 5, Pitelka *et al.*, 1955). Between two of these pairs, on June 17 and again on June 23, a boundary contest went on through most of an hour or so which one of us spent nearby while censusing a study plot. At this time actual combat occurred several times with two jaegers clashing in the air and dropping to the ground in a struggle. The observer was not close enough actually to see the bills in use, but it seemed clear from all other features of these fights that they were used, as in many similar situations in other birds.

Other, more routine territorial actions among neighbors may now be described.

There are what we may term challenge flights, usually silent, when a jaeger (A), apparently at this moment aware of a particular neighbor, approaches the periphery of his territory in the direction of the neighbor. This prompts the neighbor (B) already in flight to swing over toward the boundary in a retaliatory flight. No calling need occur, and there is therefore a good deal of territorial assertiveness manifest merely in the movements of the birds. If A moves close to the territorial limits, B may call as he reasserts by his flight his occupation of the area momentarily challenged. From observations of many such engagements, it appears that there is more or less of a neutral zone between territories, sometimes one or two hundred feet wide, as when a natural physiographic break such as a low ridge separates the preferred lowland habitat. Usually it is narrower, and occasionally very narrow or even nonexistent, as between the crowded pairs mentioned earlier.

Members of either of two neighboring pairs may venture in such a neutral zone with the possible consequences just described. If A moves through this zone to B's boundary, the retaliatory chase of B will proceed into the zone but not so far, usually, that the antagonism is reversed. When this occurs with A undertaking the chase instead, and after many such occasions, one way or the other, the fact of a neutral zone becomes clear, in spite of the monotony of the terrain over which it is difficult or impossible to detect what jaegers respond to as markers. In these situations, also, the aggravated jaeger typically ends a chase with calling and with a sudden burst of speed close to the boundary, then wheels sideways in a steep bank and returns. Persistent aggravation of a territorial bird provokes repeated and rapid attack flights, almost always accompanied by loud calling, as already described.

Territorial actions of the two sexes appear to be similar. Members of a pair regularly cooperate in the defense of the home area, as they do also in incubation and care of young. One adult on the wing may chase an intruder, calling as the chase occurs; its mate may support his aggression by calling from the ground or by calling and taking wing to participate in the chase or by merely following its mate, turning back when the latter does. The incubating adult will call in warning or alarm from the nest when an intruder approaches but will usually not take wing as readily as the other, free member of the pair. Like the free member of a nesting pair, the one settled on eggs may also raise its wings in threat display as it calls, but this it does without rising from the eggs. The incubating bird typically offers this display in support of the aggressive behavior of the mate on wing.

It is clear now that the territorial behavior of the Pomarine Jaeger resembles that of many passerines, but lacks song, or at any rate a regularly delivered vocal announcement. The challenge flights and retaliatory flights, the latter reinforced or not by calls, are in effect types of aggressive display functioning in territoriality. The territory of the Pomarine Jaeger subserves functions of both reproduction and self-preservation (Armstrong, 1947:274), from at least the time pairing is already completed and copulation is yet to occur, through nesting and rearing of young. It is not possible now to say to what extent, on a population basis, prenuptial display and pairing occur on the territory. Events of 1953, about June 1, suggested that some jaegers may arrive already paired. But it is certain that on some territories, prenuptial display and pairing occur as well as all the remaining activities of the breeding cycle.

In 1952, observations that continued through August and early September provide certain facts about territoriality in the latter part of the nesting cycle. In the first week of August, and hence in the period young were being fed, changes in the limits and areas of territories were occurring, and at least those pairs noted by us were enlarging their foraging ranges. This was true of pairs with territories near the ocean shore, which

now were noted feeding along the shore. It was also true of a pair marked with paint by D. Q. Thompson which extended its hunting over an area frequented by us and not earlier used regularly by that pair, or by other jaegers. This spread of hunting effort occurred when young were two or three weeks old, and the general mid-summer scarcity of lemmings was apparently responsible for it. Defense of some territories continued as late as August 30, when, on at least two territories, young were attended singly by an adult. At several territories close to Elson Lagoon, young left to fly out over the lagoon where they chased Glaucous Gulls (*Larus hyperboreus*) and picked up food disgorged by the gulls. Young thus roaming and foraging were observed to return to adults whose own movements were still local and who usually did not accompany the young away from the territory. The indications are that adults on territories with advanced young may remain attached to these areas while young are already progressing toward independence.

Contrary to Salomonsen (1951:262, 270), then, the organization of breeding populations in the Pomarine Jaeger should not be referred to as "colonial"; nesting pairs are territorial in every sense of the word. This matter is discussed by us more fully elsewhere (Pitelka *et al.*, 1955).

Pairing display.—On numerous occasions in June, birds in two's on the ground performed together or singly a display evidently significant in pairing or maintenance of the pair-bond. In some instances later events indicated the pair was still unformed, whereas in others, the two birds continued to associate and to respond to others as a pair. Other displays, overtly similar in certain features, are also mentioned here, but the full repertoire of display behavior, by modern standards of ethology, remains to be described.

In the display associated with pairing, one jaeger receives another that is about to alight by raising and pulling back its head, puffing its breast feathers, raising and spreading its tail slightly, and then elevating the two elongate rectrices above the plane of the tail. Also, the bill may be lifted and lowered, but this was never seen to occur rhythmically. What vocalizations other than the usual loud calls accompany this display cannot be said; usually in the field the wind prevented hearing any soft notes. Occasionally both of two birds would perform this display facing each other; then one would turn and perhaps also walk a short distance away. The erected rectrices appeared to be a focal point in the display. On one occasion (June 18, 1952), two jaegers on a mound, vibrating their wings and holding their heads high, alternately displayed before each other. In the course of an attempted but unsuccessful copulation watched on June 24, 1953, the male would hold his head high facing forward and puff his neck feathers prior to advances thwarted by the female moving forward. On other occasions, copulation was preceded by the display with raised central rectrices, as described. Still other copulations were not preceded by any visible display actions.

The pairing display was also seen in groups of three birds, at a spot later occupied by a breeding pair, and two of these would display before the third. Such a group, witnessed several times, would break up soon, with two or all three taking wing, and in a few instances, flight would occur as a result of aggressive gestures of one toward the second displaying bird. The aggressive bird, in extreme instances, would pull its head back and down, raise its wings partly, and dash at the other, pecking at it. Typical loud calling would occur prior to the aggression and flight. Or, two standing birds would be seen, one displaying, and a third would come along and chase the displayer, then return and remain in the area with the passive bird.

While we can only describe these incidents briefly, it is clear that a display ritual, with variations, occurs early in the breeding cycle and is significant in pairing and

apparently also in the maintenance of the pair-bond, inasmuch as through June, with pairs clearly settled on an area, the display would be seen presumably after pairing had been completed. Certain elements in this display apparently have no relation to territorial contests, except insofar as one member of a forming pair repulses a single bird which may be from a neighboring area attempting to associate with it. On the other hand, the raised-wing display, a gesture of aggression used in the course of pairing, is used subsequently by territorially established birds, as described. A raised-wing display occurs also in the Great Skua, and with similar function (Murphy, 1946:1026, 1032; Witherby *et al.*, 1941:124). In many features of display, the Pomarine Jaeger also resembles some of the larger gulls, but information available for the jaeger is too fragmentary to justify comparisons now.

Distraction display.—*Stercorarius pomarinus* does not perform a distraction display, and aggressive actions described under territoriality are the only ones manifest when a human approaches a nest. Near time of hatching, both members of a pair, but particularly the female, merely become more ferocious. In this respect, *pomarinus* contrasts with *parasiticus*, which has a routine distraction display; this was witnessed in a single nesting pair, both members displaying, at Barrow in 1952 (see also Salomonsen, 1951:271). *S. longicaudus* is stated by Witherby *et al.* (1941:138) to have a distraction display. Manniche (1910:173) does not mention or even hint at one, Soper (1946:234) reports he never observed *longicaudus* in such display, and Salomonsen (1951:282) states flatly that the species "does not feign injury as the Arctic Skua" (Parasitic Jaeger); but Birulya (1907:60), Deichmann (1909:152) and Sutton (1932:167) can be cited in support of Witherby *et al.* In this respect, then, *longicaudus* appears to be variable and thus contrasts with the other two species, of which one has a well-developed distraction display whereas the second has none.

Other notes on behavior.—Study of the accounts of the Great Skua written by Selous (1901), Pitt (1922), Murphy (1936), and others impresses one with the fact that in many basic traits of behavior, *Stercorarius skua* and *S. pomarinus* resemble each other closely. Among these traits are the generally hawk-like behavior of both, their massive strength combined with maneuverability, vigorous defense of territories and nests, their aggressive diving and manner of striking, their persistence in attacking an intruder, their raised-wing display, their lack of a distraction display, their clamorousness, and various aspects of behavior referred directly to nest or young. Murphy (1936:1029) noted that wounded skuas did not utter cries. This we found true also for Pomarine and Parasitic jaegers, for those lamed in collecting as well as for those found lamed with a broken wing or caught in a fox trap. Comparative investigation of behavior may bring out differences in details between *skua* and *pomarinus*. But a fact worth emphasizing here is that while their general behavior patterns are similar, there is a significant difference between them at the population level, in spatial organization and food dependences of breeding pairs, *skua* being properly termed a semi-colonial species, whereas *pomarinus* is not colonial but rather territorial in all senses of the word.

In 1953, when Brant nested abundantly in the Barrow area, their nests were not molested by jaegers even though these were easily located when the female was incubating and even though the eggs were occasionally left uncovered. A pair of jaegers regularly and persistently harried a male Brant when one of us entered their territory. In this action, the Brant would stoop and run ahead slightly to avoid the plunging jaeger. It would grunt repeatedly, particularly if incited to face the jaegers directly; then it would raise its wings slightly to meet the threat. Occasionally, it would take wing in brief sallies when the jaeger came close, and this was the most aggressive retaliation. The Brants' nest was about 75 feet away from that of the jaegers, and

after observation of several sequences of the behavior described, it became clear that the close association of these birds was normally peaceful, but that in the presence of a man, the jaegers addressed their aggression to the Brant rather than to the man. If the female Brant left its nest and the pair then moved at least two or three hundred feet away, the jaegers would leave them alone and then fly over the man if he remained nearby. At no time was there any gesture of molestation by the jaegers at the Brants' nest, and the young goslings were led away from the area successfully. Dementiev *et al.* (1951:397), however, state that the Parasitic Jaeger preys on eggs of the White-fronted Goose (*Anser albifrons*).

Juvenal jaegers harass other birds soon after learning to fly. Their attacks on Glaucous Gulls in early September were mentioned earlier. In addition, on September 8, 1952, three juvenal jaegers were observed attacking a juvenal Snowy Owl, which then was able to fly well.

SNOWY OWL

As elsewhere in the arctic, in northern Alaska the Snowy Owl is a resident species, remaining through the winter when lemmings are common (Bailey, 1948:265). The literature on the Snowy Owl is far more extensive than that on the Pomarine Jaeger, and what information we gathered agrees closely with reports of earlier observers (Pleske, 1928; Murie, 1929; Sutton, 1932; Bent, 1938; Witherby *et al.*, 1940; and Salomonsen, 1951).

Habitat.—One feature of nest location detected among the 10 sites near Barrow in 1952 and 1953 does not receive any comment by previous writers. There, nests are placed on high polygons or on raised parts of better-drained ground, as a low ridge, and in eight of these sites, the nest was placed with reference to a slope bordering a drainage axis so that the incubating owl had what for the flat tundra terrain was a relatively generous vista. As we observed, the female leaving the nest could slip off, flying low and even coasting along the slope into the drainage axis, then moving up on the other side; or it could fly back away from the nest, over polygons or a ridge. Two nests were located on high polygons in areas not immediately sloping off into a drainage axis, but not more than several hundred yards from one. As nesting is begun early, a spot of bare ground is of course most likely to be available on raised ground and also near slopes where snow drifting would result in thinner snow cover on the adjacent high ground. These factors must figure not only in location of the nest site but also in the effectiveness of the owl in hunting. But it is our impression that more is involved, since the very physiography of these sites enables the owl to give itself what little measure of protection the terrain can offer in that it can leave or approach a nest with good chance of avoiding detection, at least through May and in early June. The fact was that in 1953 the subtleties of this physiographic configuration around a Snowy Owl nest were sufficiently impressed upon us so that on June 16, when the last four nests were found, two of them were spotted directly, in an area occupied by owls, by mere choice of what seemed to be the most "ideal" part of the terrain!

Breeding schedule.—The nesting cycle lasts over three months, probably $3\frac{1}{2}$ months. Nesting begins in the latter half of May or early June. From hatching records as well as nests found early, we estimated that in 1952 clutches were begun in the period from June 5 to 10, whereas in 1953, they were begun in the period from May 15 to 20.

The incubation period is 32 to 33 days (Pleske, 1928:166; Murie, 1929:8). Eggs hatch in late June and the first half of July. When 20 to 25 days old, young may wander from the nest mound and remain nearby. According to Witherby *et al.* (1940:310), young in captivity begin to fly at ages of 51 to 57 days, and on this basis, young at

Barrow, in such a year as 1953, would not take wing earlier than about August 10. We were unable to determine directly the age at which young take wing, but one young kept by us in an outdoor cage and given opportunity to move about almost daily performed its first successful short-distance flight on August 13 when it was about seven weeks old. One juvenile in 1952 observed on September 8 was in flight and unattended by adults.

The lengths of the periods over which young are dependent and then semi-dependent are not known, hence the uncertainty indicated concerning the length of the nesting cycle. On the basis of the situation at Barrow, it would appear reasonable that the young are largely if not entirely independent by the last week of August or the first week of September. This is a guess, however, which we have ventured in the interest of a usable approximation of the time required by nesting.

Territorial behavior and display.—In 1953, hooting and pairing activity at Barrow was recorded from May 17 (earliest date of field work) to May 28. In 1952, no regular hooting was heard in late May or early June, but occasional hooting was recorded in middle and late June. We did not witness the large-scale hooting of territorial birds described by Sutton (1932:206), but the breeding population observed by him was evidently much denser than the one near Barrow.

Nesting pairs near Barrow were widely spaced out, usually one to four miles apart, or even farther. No territorial conflict between known neighboring pairs was witnessed. It is likely, however, that what territorial differences occurred were largely settled in April or May, well before our field work began. The areas occupied by nesting pairs were mutually exclusive, so far as we could judge by their local movements. The available evidence on territoriality, ours as well as that in the literature, is scant and largely circumstantial, but there is no reason to expect that this owl would differ from temperate-zone owls.

On May 27, 1953, in one area near the ocean shore some distance away from nesting areas, one male repeatedly chased a second, dark bird, which may have been a female or a young male. The latter returned the chases several times, and on one such occasion, the male, remaining on the ground, faced its approaching opponent by stooping slightly and holding its wings out partly. This was evidently a threat display, which incidentally resembles the courtship display. Later, the light-colored bird took wing and the dark bird followed, swooping toward the first in a mid-air dash. The former continued its flight while the dark bird returned to the area. Owls did not nest in this area, but the behavior observed is probably typical of territorial bickering.

Non-breeding owls do not react to each other aggressively, and indeed may occur in local concentrations. Thus, in 1953, on several occasions in mid-June, 20 to 30 owls were seen scattered and resting on areas of no more than 50 to 75 acres. Smaller local concentrations were seen in 1952, as well as later in 1953. Thus, while Salomonsen (1951:467) may be correct in saying this owl "is not gregarious," it is not anti-social, so to speak, to the extent that individuals habitually isolate themselves.

The "courtship antics" described by Sutton (1932:209) consist only of the territorial hooting in which the male, in the manner of the Horned Owl (*Bubo virginianus*), calls with lifted tail. A pairing display witnessed by us on two occasions we do not find described in the literature. A sequence observed on May 24, 1953, is described in Tomich's original notes as follows: "A brown-plumaged bird [female] was making short flights across the snow, evidently hunting lemmings. Its manner was to hop four or five feet, or ten feet, with the aid of the wings. A white owl [male] then came over the ridge at an angle and alighted on snow some 50 feet from the first owl. It carried a dark object, likely a lemming, in its bill, and the brown owl flew immediately to it,

perching behind it. The white owl stood with its wings raised and leaning forward about a minute. Then it turned to one side, maintaining the raised-wing attitude. The brown owl stood quietly." A similar sequence was witnessed on May 28, although we were unable on that date to ascertain whether the white individual held anything in his bill.

SHORT-EARED OWL

Near Barrow, the Short-eared Owl occurs rather irregularly (Bailey, 1948:268). In 1953, it nested commonly and was present from May 24 until observations were stopped in August. In the main, breeding behavior witnessed by us was similar to that already described in the literature, but for so widely distributed a species, the available information is surprisingly limited. For this reason, and because we are dealing with a population at a high latitude, a complete summary of our observations is given here.

Habitat.—Although Short-ears could be encountered almost anywhere on the tundra, they were most numerous in areas of broken tundra where slight rises provided good vantage points. Nest sites were characteristically on relatively high ground, on ridges or polygons, where a coarse grass (*Arctogrostis latifolia*) generally ignored by lemmings provided just about the only cover the owl could use to some advantage. Even so, the nests were conspicuous and easily seen from overhead as the old grass culms and blades forming the shelter for the nest were rarely more than six to eight inches long and then rather sparse and more or less inclined. A few nests were placed on lower ground, on better drained parts of marsh flats, where remains of dense growths of grass (*Dupontia*) and sedges (*Carex* and *Eriophorum*) provided a site for the nest bowl. In all cases, once the location of the nest was known, the incubating bird usually could be seen from a distance of 50 to 100 feet.

Breeding schedule.—Pairing and establishment of territories occurred in the first week of June. The first records of eggs, on June 11, as also the span of time over which new clutches were started, are shown in figure 1. On the basis of the time intervals indicated in that figure, eggs are laid usually one every two days, and according to Witherby *et al.* (1940:333), this is the general rule. But in some clutches, certain intervals may be shorter, approaching one day (nest 4); others may be longer — as many as four days (nest 3). Longer intervals "of up to a week" are known (Witherby). In all these estimations allowance is made for the possibility that any given egg may have been laid on an earlier date which is blank in the record (fig. 1).

On the basis of data and estimates just given, first eggs were laid in 1953 near Barrow from June 6 to June 22 or 23. In addition to data given in figure 1, two females collected on June 8 were in pre-laying stage and contained enlarged ova, to 12 and 5 mm., in a first-year and an adult individual, respectively. Both of these females, 406 and 475 grams in weight, had light fat. Age distinction is based on the presence of worn flight feathers and wing coverts of the juvenal plumage in first-year birds (Witherby *et al.*, 1940:331).

Females occupy the nest site in incubating position before the first egg is laid and probably after that egg is ovulated. At nest 4 (fig. 1), the female was found thus on June 20, and the nest contained one egg on June 23 (not checked the 21st or 22nd). At a second nest site, on June 9, a "broody" female flushed from an empty nest gave a single low, grunt-like hoot and actually performed a distraction display for three or four seconds about 50 feet from the nest before again taking wing and flying farther away.

Pair 4 was regularly present on a small area at the north end of census plot 1, and our repeated, unsuccessful efforts to find the nest puzzled us when other nests were found

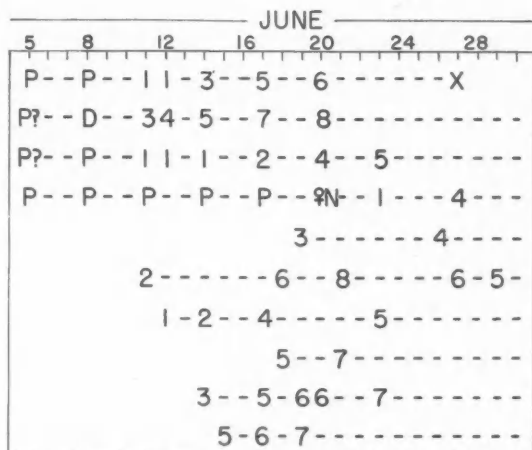


Fig. 1. Time records of establishment of pairs and egg-laying in ten nests of Short-eared Owls near Barrow, Alaska, in 1953; P, pair present near site where nest was later found; D, pair in display over nesting area; P?, female on nest cavity; numbers indicate counts of eggs on successive visits to nests; X, nest found destroyed. At nest 6, female continued incubating through period when three eggs disappeared, but the nest with five eggs was found deserted on August 5.

so easily. As is shown in figure 1, this pair was actually present on a territory fully two weeks before its nesting was started.

The difference in patterning between males and females (Bent, 1938:174), particularly that in the wing, was sufficiently clear that while our field work was in progress, we noted that without exception only the female incubates. This agrees with Witherby and also with Dementiev *et al.* (1951:387), but not with Bent (1938:172). Saunders (1923:122) also states that only the female attends the nest, in this case a nest with young. This matter deserves emphasis since Bent's error is perpetuated in the recent extensive study of incubation behavior by Kendeigh (1952:215).

Incubation periods estimated from successive nest observations are as follows:

Nest	Egg	Period	Dates
2	1st	At least 26 days	June 6-July 2 ¹
3	Last (5th)	At least 37 days	June 22-July 29 ²
11	1st and 2nd	30 days	June 6-8 to July 6-8
10	1st and 2nd	About 28 days	June 9-11 to July 6-8

¹ Egg still unhatched.

² Egg hatched no earlier than 29th.

For mid-latitudes, as given by Witherby *et al.* (1940:333), the incubation period is 24 to 28 days. The period given by Bent (1938:172) is shorter and probably unreliable. For the Barrow region, so far as the data go, incubation evidently may take no longer than it does at lower latitudes, but the average, as also overall variation, is probably greater. There is no mistake about the 37-day calculation given above.

On the basis of an average incubation period of 26 days, in the most advanced nests near Barrow in 1953, newly hatched young would be expected about July 3. The first young found was hatched on July 6 from a clutch the earliest egg of which we estimate was laid on June 6. All other hatchings occurred later. Thus, all indications are that incubation requires longer than 26 days.

Although both sexes care for the young, the female alone broods and continues this even after young leave the nest cavity. Thus, brooding still occurred on July 30, when a female was observed over the two youngest owls which had moved from their nest four feet away, while at distances of 20 to 100 feet farther away, five older ones rested. Where thriving young were observed in July and August, both adults were usually seen.

According to Witherby *et al.* (1940:333), young leave the nest after 12 to 17 days. It may be expected that at higher latitudes the period of nestling life would average longer. Heat quantities are lower and we have already seen that what evidence is available suggests that the incubation period may average slightly longer at higher latitudes. Regarding nestling period, we know that at one nest when the five young were 21 to 31 (± 1) days old, none had yet left the nest. On the other hand, at another nest the oldest young, known to be 16 or 17 days old on July 22, was found on that date 20 feet from the nest, which then contained three other young and two eggs. Thus, what evidence we have indicates that young may leave the nest after intervals as short as some recorded at mid-latitudes but others may remain in the nest longer.

We did not succeed in determining the age at which young begin to fly; according to Witherby, this is 24 to 27 days, while Urner (1923:33) estimates it at 31 to 36 days. On the basis of these estimates, near Barrow young would not be seen on wing any earlier, in 1953, than the last week in July. Our first record for a young bird in flight was August 8.

The period of dependence after young take wing is apparently unknown. According to Urner (1923:32), this is at least one to two weeks [or the difference between 31 to 36 days and six weeks after hatching, not six weeks after young are able to fly, as misstated by Bent (1938:172) in citing Urner]. In a medium-sized owl, the estimate of one to two weeks is surely conservative; for the better known Long-eared Owl (*Asio wilsonianus*), the period of dependence after flight is said to be three to four weeks (Bent, 1938:158). At Barrow we were unable to observe young in late stages of development, but in the light of facts just given, it is unlikely that any would have become independent before the middle of August.

Counting from the first week of June, then, we arrive at a minimal estimate of 11 or 12 weeks for the nesting cycle.

Territorial behavior and display.—The aerial display of territorial birds, circling over home areas, was seen many times in the period from June 5 to 11. During mid-day on June 5, the wing-flapping sound of displaying birds could be heard from all directions over and in the vicinity of a census plot on a beach ridge along which nest sites were relatively numerous. In the lower light of the evening on the same date, owls were grounded.

The most frequent call given in the aerial display was a single-noted harsh scream, like that of the Barn Owl (*Tyto alba*) uttered in flight over its foraging area, but the note of the Short-ear was less drawn out and lower pitched. This is presumably the harsh flight note mentioned by Witherby *et al.* (1940:332). It is a note evidently significant in situations of aggression, as it was heard most frequently on June 5 and 6 when displaying and chasing occurred generally. The hooting given on wing often just before a dive and wing-flapping sequence, consisted of 9 to 12 notes given about three

per second. These were short, sharp hoots, delivered regularly. Hooting and flight displays were observed essentially as described by various authors (Dubois, 1924; Francis Harper in Bent, 1938:170; Witherby *et al.*, *loc. cit.*).

Hooting and aerial display occurred at considerable heights above the ground, easily two or three hundred feet, where the owls were above the traffic of jaegers and were ignored by them. Short-ears display at such heights likewise at mid-latitudes; hence, this habit does not appear to have any direct adaptive relation to the presence of jaegers. Still it is interesting that some locally settled owls in attempting to elude jaegers on the wing did so by climbing higher when harassed.

Territorial behavior occurred clearly only in conjunction with the aerial display given at the beginning of the nesting cycle. Thus, in the period from June 5 to 11, when birds in display were observed frequently, they circled over their respective territories, announcing themselves with hoots and wing-flapping and intermittently giving the aggressive note mentioned above. Occasionally a displaying male swerved over to chase a neighboring bird, often giving the aggressive note in the course of the chase. These chases were deliberate and vigorous, and there seemed to be no doubt that although the birds were flying at a considerable height, their behavior was referred to some fairly definite area below. In the course of the high flights, particularly on June 5 and 6, on some territories two birds of a pair or forming pair would be on wing, both circling more or less independently, the male dropping into a flapping sequence when he happened to be close to the other bird as well as at other points in his circling. So far as we could tell, but one bird, presumed to be the male, did all the displaying and most if not all the calling.

Aerial display continued until June 11, and then was witnessed only a few times until the 20th. Such late display occurred in particular near one site on a census plot visited regularly. There the nest with the first egg was found on June 23.

No aggressive behavior among Short-eared Owls was observed after this period in which most nests were started. None occurred among owls flying about low when disturbed or in the course of their normal movements about the tundra. Indeed, certain flights of owls harassed by jaegers or flushed by one of us occurred over distances of up to $\frac{1}{4}$ or $\frac{1}{2}$ mile, and there was no doubt in these instances that the owl was crossing the areas occupied by other Short-ears. Thus, a dispersion of breeding pairs achieved early in the nesting cycle was not abetted by persistent aggression among neighbors. An ornithologist coming to the tundra after June 11 might think these owls were non-territorial. But the facts are that the breeding population became dispersed through available habitat in the course of a week's time when the owls in display were actively territorial.

Once the period of active aerial display was over, the activity areas of the owls were still largely separate, and the long flights just mentioned occurred relatively infrequently. This situation, incidentally, is similar to that in the Lapland Longspur (*Calcarius lapponicus*), which some writers state is non-territorial, presumably because of the amount of overlap in activity areas of neighboring pairs in the latter part of the nesting cycle.

Distraction display.—Distraction display or "injury feigning" was not observed in any conspicuous or persistent form. One instance has already been mentioned — that of a "broody" female flushed from a nest cavity. Another, flushed from a nest in the egg-laying period, flew over the observer and called *ki-rrr*. This shrill note was given several times followed by bill snapping, then another series of calls followed by bill snapping again. At a second nest, a female left and flopped along on the ground for a short distance before taking wing. No wing clapping of the type used in aerial display was

witnessed when the female was flushed from the nest. On all of the other and many occasions when a bird was flushed from its nest, it simply took wing and flew some distance before settling down or circling back and coming down several hundred feet from the observer and nest.

Witherby *et al.* (1940:333) state "injury feigning" is frequent. It seems possible that the fact of infrequent observation of injury feigning in the Barrow region Short-eareds may be significant in view of the risks suffered by owls' nests in the presence of abundant jaegers. In general once a clutch was completed, owls disturbed from them left in an undemonstrative way. But the white eggs left exposed were conspicuous, and losses of nests with eggs were considerable, due probably as much to the degree of disturbance suffered by the owls because of intrusions by ecologists and Eskimos as to subhuman enemies!

SUMMARY

Noteworthy observations on breeding behavior of the Pomarine Jaeger, Snowy Owl, and Short-eared Owl near Barrow, Alaska, in 1952 and 1953, are reported. The breeding of all three depends here on the availability of brown lemmings, which in 1953 passed through a cyclic high.

Breeding pairs of the Pomarine Jaeger establish territories on marshy flats and extensive lowlands characteristic of the arctic coastal plain. Clutches of 1 or 2 eggs are laid; there is no satisfactory evidence that clutches in this species may be larger. Incubation lasts 27 to 28 days. Young are dependent for at least six or seven weeks. The nesting cycle lasts 10 or 11 weeks. Territories subserve functions of reproduction and self-preservation. Territorial behavior, comparable in the two sexes, continues throughout the nesting cycle. In all basic features except vocal announcement, which is lacking, the territorial behavior of this jaeger resembles that of many passerines. A display ritual apparently functioning in pairing and pair-bonding is described. This species of jaeger does not perform a distraction display.

Near Barrow, Snowy Owls typically place nests on high ground adjacent to a gently sloping drainage axis. Breeding pairs are spaced out and in this sense truly territorial, as might be expected with a large predator, but good evidence on defensive and aggressive behavior is lacking. The nesting cycle is estimated to last three months, probably $3\frac{1}{2}$ months. A courtship display of the male is described.

By contrast with the other two avian predators depending on lemmings, Short-eared Owls nested near Barrow in 1953 but not in 1952. Territories were established in early June. First eggs were laid from June 6 to 23. Incubation required 28 to 30 days, the female alone incubating. Young unable to fly left the nest cavity at ages of 17 to 30 days. Early in June aerial display serving in territorial establishment and announcement was frequent, as also aggression among neighboring owls; but such behavior was not recorded after June 20. The nesting cycle spanned 11 or 12 weeks. Distraction display occurred infrequently; in this respect the Short-eareds of the Barrow area appeared to contrast with those of mid-latitudes.

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LITERATURE CITED

- Armstrong, E. A.
1947. Bird display and behaviour (London, L. Drummond), 430 pp.
- Bailey, A. M.
1948. Birds of arctic Alaska. Colorado Mus. Nat. Hist., Pop. Series no. 8, 317 pp.
- Bent, A. C.
1921. Life histories of North American gulls and terns. Bull. U. S. Nat. Mus. 113:x + 345 pp.
1938. Life histories of North American birds of prey (part 2). Bull. U. S. Nat. Mus. 170:vii + 482 pp.
- Birulya, A.
1907. Ocherki iz zhizni ptits polyarnago poberezhya Sibiri. Zap. Imp. Acad. Nauk, ser. 8, 18 (no. 2):xxxvi + 157 pp.
- Deichman, H.
1909. Birds of east Greenland. Medd. om Grønland, 29:141-156.
- Dementiev, G. P., Gladkov, N. A., Ptushenko, E. S., Spangenberg, E. P., and Sudilovskaya, A. M.
1951. Ptitsy Sovetskogo Soyuza. Vols. 1 and 3 (Moscow, State Publishing House), 652 and 680 pp.
- Dubois, A. D.
1924. The nuptial song-flight of the short-eared owl. Auk, 41:260-263.
- Kendeigh, S. C.
1952. Parental care and its evolution in birds. Illinois Biol. Mono., 22 (nos. 1-3):x + 356 pp.
- Kumlien, L.
1879. Birds. In "Contributions to the natural history of arctic America" (Washington, Gov't Printing Office), pp. 69-106.
- Manniche, A. L. V.
1910. The terrestrial mammals and birds of northeast Greenland. Danmark-Eksped. til Grønlands Nordostkyst 1906-1908, 5 (no. 1): 1-200.
- Murie, O. J.
1929. Nesting of the snowy owl. Condor, 31:3-12.
- Murphy, R. C.
1936. Oceanic birds of South America. Vol. 2 (New York, Amer. Mus. Nat. Hist.), pp. 643-1245.
- Pitelka, F. A., Tomich, P. Q., and Treichel, G. W.
1955. Ecological relations of jaegers and owls as lemming predators near Barrow, Alaska. Ecol. Mono., 25:85-117.
- Pitt, F.
1922. The great and arctic skuas in the Shetlands. Part 1. The great skua. British Birds, 15:174-181.
- Pleske, T.
1928. Birds of the Eurasian tundra. Mem. Boston Soc. Nat. Hist., 6:iv + 111-485.
- Salomonsen, F.
1951. Grønlands Fugle. Parts 2 and 3 (Copenhagen, Ejnar Munksgaard), pp. 159-608.
- Saunders, A. A.
1913. Some notes on the nesting of the short-eared owl. Condor, 15:121-125.

Selous, E.

1901. Bird-watching (London, J. M. Dent and Co.), xi + 347 pp.

Soper, J. D.

1946. Ornithological results of the Baffin Island expeditions . . . Auk, 63:223-239, 418-427.

Sutton, G. M.

1932. The birds of Southampton Island. Mem. Carnegie Mus., 12 (section 2):1-275.

Urner, C. A.

1923. Notes on the short-eared owl. Auk, 40:30-36.

Witherby, H. F., Jourdain, F. C. R., Ticehurst, N. F., and Tucker, B. W.

1940-41. The handbook of British birds. Vols. 2 and 5 (London, H. G. F. Witherby, Ltd.),
xiv + 352 pp.; xii + 356 pp.

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COURTSHIP ACTIVITIES OF THE ANATIDAE IN EASTERN WASHINGTON

By PAUL A. JOHNSGARD

The many interesting and sometimes spectacular aspects of waterfowl courtship have been observed and recorded by several writers. Among the best and most complete descriptions are those of Bent (1923, 1925), Townsend (1910, 1916), Wetmore (1920), and Hochbaum (1944). However, for the most part these are unillustrated, deal with only a few species, or are based on limited observations.

In the summer of 1953 and the spring and summer of 1954 the writer did extensive field work in the Potholes Region of Grant County, Washington, gathering data for an ecological study of the birds and vegetation of that section. In the spring of 1954 he had occasion to observe epigamic activities of most species of waterfowl that are found in that region and was able roughly to delimit the periods of courtship and mating for several species. Determinations of sex-ratio for 15,434 waterfowl were made during the period from February 15 to May 15, 1954, and some of these data are presented in this paper, but a full discussion of the ratios and their significance will be deferred until a later time. The objectives of the present paper are to add descriptive material in the case of those species for which published observations are incomplete, to illustrate most of the basic actions seen, and to compare periods of courting among several species.

The area of study centers about a Columbia Basin Project dam, O'Sullivan Dam, and Potholes Reservoir. Adjacent to the reservoir is located a large area of sand dunes; between the bases of the dunes are found numerous potholes of various sizes. Below the dam seepage water has accumulated in many depressions and glacial-cut "scabland" channels, which usually remain open the year around. During the winter of 1953-54 many species of waterfowl wintered here, including all species discussed here except the Blue-winged Teal, Cinnamon Teal, and Barrow Goldeneye.

The four major ecological areas studied and roughly portrayed in figures 1 and 2 are as follows: (1) deep, rock-bound seepage lakes, in scabland channels (figs. 1D, 2C), on which Canvasbacks, goldeneyes, scaups, and Redheads often courted; (2) shallow seepage potholes below O'Sullivan Dam, which were usually bordered by sagebrush (*Artemisia tridentata*), and on which many species of surface-feeding ducks courted (fig. 1B); (3) the shore line, or "feather-edge" of Potholes Reservoir, adjacent to the sand dune potholes, where mergansers and Buffleheads often courted (fig. 2B, D); and (4) the sand dune potholes, where Ring-necked Ducks, Common Goldeneyes, Buffleheads, and some surface-feeding ducks courted (figs. 1A, 2A).

Before entering into descriptive accounts of each species, certain generalized observations may be presented. A surprising variation in time of courtship among various species was observed; Mallards, Pintails, Baldpates, and Gadwalls were nearly all paired by mid-February, while Ruddy Ducks did not begin pairing until mid-May. Species also varied greatly in regard to frequency and intensity of courtship activities. In general it may be said that the more disproportionate the sex-ratio, the more obvious and greatly extended the period of courtship display. Courting flights were not commonly observed except among scaups and Buffleheads. Certain species, notably the Bufflehead and Common Goldeneye, continued display activities well after it was apparent that the birds were already paired. Immature birds of these two species also actively engaged in courtship, although neither species mates until its second year (Kortright, 1942). In no case was an early migration of paired birds followed by a later migration of non-paired birds, although in several cases the opposite appeared to be true.

Certain actions, illustrated in a single species, apply to a large group of waterfowl. These may be grouped into three classes, as follows:

Action typical of all species of waterfowl observed.—These include a “standing up” accompanied by a vigorous wing-flapping (fig. 1A, left background), and a “head-dipping,” which consists of a sudden dipping of the head into the water followed by rapid backward movement of the head to its normal upright position (fig. 1A, left background), causing water to flow down over the breast and back; this last is usually fol-

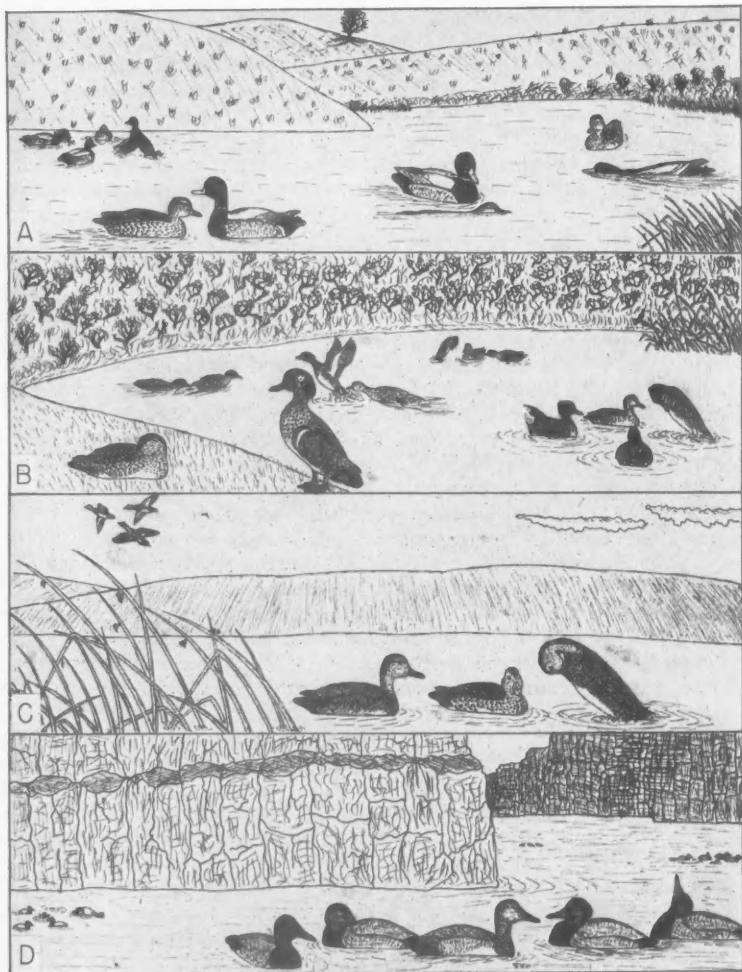


Fig. 1. Courtship mannerisms of the Mallard (A), Green-winged Teal (B), Gadwall (C), and Canvasback (D).

lowed by a sidewise shaking of the tail. These actions may also be observed, usually to a lesser degree, during other periods of tension, as in territorial defense and brood protection. Preening (fig. 2D, left background) is commonly observed during courtship activities. Although both sexes indulge in these actions, the male does so more frequently.

Actions typical of surface-feeding ducks.—Head-bobbing, a deliberate up-and-downward movement of the head, is common to males of most surface-feeding ducks. Females respond in a similar manner. Bowing (fig. 1B, C) is practiced by males of many species of surface-feeding ducks.

Actions typical of diving ducks.—"Flock pursuit" (fig. 1D, 2A) is a characteristic action of most diving ducks, especially those of the genus *Aythya*. In this procedure a female leads a group of interested males in a vigorous and somewhat erratic chase; the female generally is in the lead. The "head-throw" (fig. 1D; 2A, C), where the male suddenly throws his head backward until the occiput touches his back, followed by a vigorous return to its normal position, is characteristic of all the species of the genus *Aythya* that were observed. It is also seen in goldeneyes in a somewhat more exaggerated form.

The drawings are all based on sketches made in the field. Some are probably slightly incorrect due to the rapidity with which a few of the actions were carried out as well as to the artistic limitations of the writer.

Anas platyrhynchos. Mallard.—Courtship was observed three times between February 15 and 23, inclusive; copulation was observed on February 16 and 23. The majority of females were paired at the outset of field work in mid-February. Some birds were noted to be territorial by late February, and almost all females were paired by that time.

Townsend (1916) described well the courtship of this species, and only a short resumé will be given here. Early stages of courtship are characterized by the wing-flapping and head-dipping described earlier (fig. 1A, left background). Preliminary to copulation, the male begins a continuous and deliberate up and down head bobbing. The female soon begins a similar though less noticeable head movement (fig. 1A, left foreground), and shortly thereafter copulation takes place. This procedure is similar to that in all species observed, the female lying prone on the water with only the crown of her head above the surface (fig. 1A, center foreground), or sometimes with even this almost submerged. The male promptly mounts and the act is completed in a few seconds. Following copulation the male swims swiftly about in random circles, with the front of his body low in the water (fig. 1, right foreground). Both sexes then vigorously flap their wings and dip their heads in the manner previously described.

The sex-ratio remained stable throughout the period from February 15 to May 15, that of 4910 birds being 131 ♂♂:100 ♀♀.

Anas acuta. Pintail.—Courtship was observed twice, on March 15 and April 12, although most birds were paired by mid-February. Typical actions include fighting among the males, head-dipping, and wing-flapping, but none of the bowing described by Bent (1923). Sometimes the female flies a short distance away from the fighting drakes, soon to be followed by them. Nearly all females were paired by the end of February, and some birds were territorial by early May.

The sex-ratio varied little throughout the period, that of 1049 birds being 126 ♂♂:100 ♀♀.

Anas carolinensis. Green-winged Teal.—Courtship was observed four times in the period from February 21 to April 8. Copulation was observed on March 10. Paired birds were first recorded on February 22; most females were paired by mid-March. Territorial birds were first noted in late April.

Little has been published on the courtship of this species, the account of Sutton, quoted by Bent (1923), being the only reference known to me. That description is based on a single observation and is quite different from the actions I observed. The observation of February 21 is typical of all those which have been witnessed. Two males and two females were seen on a small seepage pothole; one female was entirely ignored by the males. The usual sequence of actions was as follows: a male swam near the female, generally facing her, and then suddenly raised his body out of the water at about a forty-five degree angle, rapidly bringing his head downward until his bill touched his breast; simultaneously he raised his crest (fig. 1B, right foreground). He immediately returned to a sitting position, at which time he either wagged his tail, or, more commonly, stretched his head out directly forward (fig. 1B, right background); he then jerked his head far back to an upright position, at the same time raising his tail feathers and wings, still folded, over his back (fig. 1B, right foreground). The entire series of movements was done with great rapidity, requiring less than two or three seconds. This speed, plus the highly animated action of the bird, made it an amusing, although beautiful sight. The only noticeable reaction of the female to this was an occasional, fairly rapid forward and backward moving of her head, similar to that of a Coot (*Fulica americana*). Distance made it impossible to determine what noises, if any, were made during the performance. Occasionally a female chases away an intruding male (fig. 1B, center), and this victim often spends his wrath on another nearby male (fig. 1B, left).

The Green-winged Teal was the only species observed to engage in courtship on dry land. On April 8, five males and two females were observed in courtship, part of which was carried out on shore (fig. 1B, foreground). The actions of the males were the same as those described earlier, modified only slightly to fit the different conditions.

The sex-ratio of this species varied little through the spring period, that of 863 birds being 114:100.

Anas discors. Blue-winged Teal.—No courtship was observed; all birds were paired upon arrival on April 29. The sex ratio appeared to be even, that of 42 birds being 100:100. Ratios following May also remained equal until females began nesting.

The courtship has been described by Bennett (1938), and it appears to consist mainly of head-bobbing. This action is observed among pairs obviously already mated when a male approaches the mate of another male too closely; the mutual bobbing of heads is definitely a threat attitude. Head-bobbing is also observed in the summer among territorial birds. The species was noted to be territorial by early May.

Anas cyanoptera. Cinnamon Teal.—No courtship was observed by me. Almost all birds were paired upon arrival on April 10, and the sex-ratio until May 15 was nearly even, that of 114 birds being 97:100. As in the Blue-winged Teal, later migrants also were nearly all mated birds. The species was noted to be territorial by late April.

Dawson, quoted by Bent (1923), described the courtship, which seems similar to that of the Blue-winged Teal. Allen Greene of the United States Fish and Wildlife Service noted four males and three females courting on Lake Lenore National Wildlife Refuge, Grant and Douglas counties, on April 20 (personal communication).

Mareca americana. Baldpate.—No courtship was observed; paired birds were recorded in mid-February and most females were paired by the end of February. The sex-ratio was fairly disproportionate for surface-feeding ducks, that of 1054 birds being 140:100. Territorial birds were observed in early May.

Wetmore (1920) described the courtship, which takes place largely in the air.

Anas streperus. Gadwall.—Courtship was observed once, on February 22; most birds were paired at the outset of field work in mid-February. The single courtship observed took place in a shallow, reed-lined pothole and involved two males and a single female.

The performance is similar to that described by Wetmore (1920) and consists of a courting flight (fig. 1C, left background) and a bowing display on the water (fig. 1C, foreground). The bow resembles that of the Green-winged Teal, but the Gadwall does not raise its body to so great an angle above the water, and the action is slower and more graceful. A high whistled *peent* usually accompanies each bow, and the female utters a low *quack* almost constantly. The feathers of the occipital region appear to be raised in an almost crest-like manner.

The sex-ratio was very nearly even throughout the migration period, that of 512 birds being 109:100. The species was noted to be territorial by early May.

Spatula clypeata. Shoveller.—Courtship was observed only once, on April 19; paired birds were first recorded on April 11, and most females were paired by late April. The sex-ratio was quite unbalanced during the entire period of migration, for 277 birds being 141:100.

The single courtship display observed consisted of a slow and deliberate head-bobbing by the four males and single female involved. This modest performance has been described by Millais (1902), and no elaboration seems necessary.

The species was first noted to be territorial in late April.

Aythya americana. Redhead.—Courtship was observed twice, on February 20 and April 9. Most females were paired in March. The sex-ratio for this species, based on 618 birds, was 152:100.

Observations of display were few, but the actions were similar to those described by Wetmore (1920). Displays consist mainly of the two actions most typical of diving ducks, the flock pursuit and the head-throw. Males actively participate in following unmated females about but only rarely perform the head-throw. No sounds, such as were described by Wetmore (1920), were heard by me, but distances at which observations were made were fairly great.

The species was observed to be territorial by early May.

Aythya valisineria. Canvasback.—Courtship was observed on seven occasions, from February 20 to March 15, by which latter date most birds departed. All females appeared unpaired during this time, although courtship was intense. The sex-ratio was highly unequal, that of 574 birds being 404:100, which may explain the frequency of courtship activities.

The courtship procedure has been well described by Hochbaum (1944) and Allen as quoted by Bent (1923). Although males of this species frequently followed the female in flock pursuit about the basalt-lined lakes they inhabited, they also often milled about in one place with the males slowly swimming around the female (fig. 1D, foreground). The typical action of the males in either case was the head-throw (fig. 1D, right foreground), accompanied by a sound which has been described by Allen as *ick, ick, cooo*. At a distance this last note sounded like distant dogs baying, or turkeys gobbling, and it had a peculiar quality which is confusing in that it sounds much farther away than it actually is. Sometimes one or more of the males appeared to tire of the chase and tucked the head under a wing (fig. 1D, center foreground), as though he were taking a short nap. However, none of the males approached the female too closely, for she assumed a threat position (fig. 1D, center foreground) preceding vigorous pecking at the male. Foraging was resumed (fig. 1D, left background) following a period of courtship activity.

Aythya collaris. Ring-necked Duck.—Courtship was observed three times in the period from March 23 to April 14. Most females paired in April, although the sex-ratio was highly unequal throughout the migration period and courting parties usually consisted of four or five males per female. The sex-ratio based on 481 birds was 163:100.

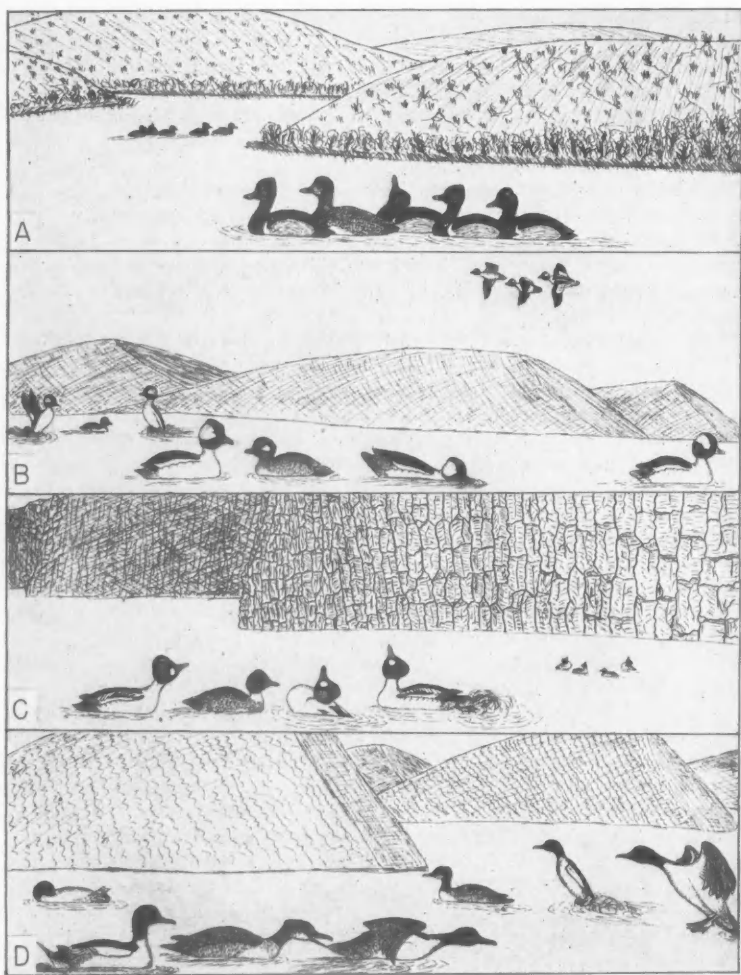


Fig. 2. Courtship mannerisms of the Ring-necked Duck (A), Bufflehead (B), Common Goldeneye (C), and Common Merganser (D).

Little has been published regarding the courtship of the Ring-necked Duck; the short description by Audubon (1840) is the only one known to me. The observations of March 29 are fairly typical. Fourteen males and four females were swimming in a small pothole. Each of the females lead a separate group of males. The males swam closely about the female, some of them with neck extended and occipital feathers raised to produce a curious angular effect (fig. 2A, foreground). This action produced a strikingly different profile from that presented under normal conditions (fig. 2A, right

foreground). The female showed no return response, except occasionally to swim ahead with a burst of speed. The males produced a sound best described as a high-pitched, mellow cheeping, much as might be expected from a song bird. Audubon (1840) described it as "the sound produced by a person blowing through a tube." The males sometimes indulged in wing-flapping; occasionally a head-throw was observed (fig. 2A, center foreground), and they often fought with one another.

Aythya affinis. Lesser Scaup.—Courtship was observed on ten occasions, from March 15 to April 19. Most females were paired during April, although courtship was intense throughout the entire period. The sex-ratio, based on 1861 birds, was 305:100.

Published accounts of the courtship activities by Audubon (1840) and Wetmore (1920) are somewhat sketchy; K. H. Gehrmann (unpublished MS) gives a detailed account. The procedure is similar to that in other species of this genus, a single female leading three or four males on a lively chase across the lake, interspersed with erratic flights of varying lengths. The female often raises her head threateningly to nearby males, but usually allows a single male to swim beside her. The males therefore make every effort to achieve this position, and often fight among themselves. Occasionally the female dives, followed by all the males, and the group reappears some distance away. Sometimes the female is observed to raise and lower her bill rapidly in the manner described by Wetmore (1920). He described the call of the male at this time as a low whistle, the female producing a rattling, purring call; I was never close enough to the birds to hear any calls.

Bucephala albeola. Bufflehead.—Courtship was observed on 15 occasions, from February 18 to April 25. Most adult females were paired by the end of March, but immature birds actively engaged in courtship during most of the time the species was present in the area. The sex-ratio for the period, based on 474 birds, was 89:100. Probably it approached 100:100, as some immature birds doubtless were mistaken for females at long distances. The ratio of 185 birds from February 15 to March 28, before immatures became common, was 103:100.

Bent (1925) presents a colorful description of the courtship of this species; my observations are somewhat similar. The most striking feature of the display is the puffed-out head feathers (fig. 2B, left foreground), which cause the white area of the head to be enlarged considerably over the normal condition (fig. 2B, right foreground). Two characteristic sequences of actions are to be noted. The more common one consists of the male swimming rapidly low in the water, with the bill on the surface and the posterior portion of the body raised, alternately extending and jerking back its head and neck, as though it were pulling itself along in the water (fig. 2B, center foreground). Sometimes a male assumes this position as a threat attitude, facing and swimming toward his opponent. Occasionally as it nears the rival male it silently and gracefully submerges, completing the attack under water. If the intended victim is unaware of this impending attack, it swims unconcerned until suddenly it explodes into the air amid a flurry of wings and water with the victorious male emerging from below.

The second characteristic sequence is as follows: a head-dip, followed by a wing-flapping, then a rapid bow similar to that of a Green-winged Teal, ending with a resounding slap of the wings against the side of the body. Male Buffleheads frequently make short flights between the various females, alighting with a splash and sliding to a stop in front of the hen, clearly showing off their white undersides (fig. 2B, left background). Courting flights (fig. 2B, right background) are often indulged in by this species.

Bucephala clangula. Common Goldeneye.—Courtship was observed on 15 occasions, from February 15 to April 19. It was difficult to determine the period and extent of

pairing, as courtship continues after actual pairing takes place. The sex-ratio for this species seemed fairly even, that of 885 birds being 116:100. As in the Bufflehead, immature males are easily confused with females at any great distance, which circumstance tends to even out the apparent ratio. The sex-ratio for the period from February 15 to March 28, before immatures were common, and based on 715 birds, was 124:100; this ratio is probably more accurate than the one for the total population.

Courtship of this species is a conspicuous and fascinating display, which has been well described by Townsend (1910) and others. Goldeneyes have developed the head-throw to its extreme, throwing the head back so vigorously that the posterior half of the body becomes completely submerged (fig. 2C, center foreground); at the same time they utter a double note, *zee-at*, which in quality reminds me of the cry of a Night-hawk (*Chordeiles minor*). The head is then rapidly brought forward to its normal position, or perhaps more commonly to about a forty-five degree angle. The bird holds this position, with neck extended, for several seconds (fig. 2C, left foreground). A second typical action is a partial head-throw, where the head is rapidly jerked upward to a position directly perpendicular to the water, usually accompanied by a frenzied kick that splashes water far behind (fig. 2C, right foreground). The female pays little attention to this activity. Occasionally she dives, whereupon she is followed by the entire group of males.

Males frequently fight among themselves, and sometimes they surprise-attack one another under water, in the same manner as described for the Bufflehead. Goldeneyes often are occupied in courtship displays, and rarely is it necessary to watch a group of these birds long before courting is observed. In fact, goldeneyes often serve as an impetus for nearby ducks of other species, such as Redheads, Canvasbacks, and Buffleheads, to begin courtship proceedings.

Bucephala islandica. Barrow Goldeneye.—Courtship was observed once, on March 26. The earliest arrival was on March 16 (Allen Greene, personal correspondence) at Lake Lenore, where the species breeds. This species is less common in this region than the Common Goldeneye, and courtship actions were noticeably different. Most birds observed were unpaired. Munro (1918) described the courtship of this species in British Columbia. Sex-ratio data are limited, that of 40 birds being 186:100.

Oxyura jamaicensis. Ruddy Duck.—Courtship was not observed by the writer, but it was noted on Turnbull National Wildlife Refuge, Spokane County, on May 15 by Irvén O. Buss (personal communication). The species is an abundant migrant, but paired birds were not observed until May 12. The sex-ratio, based on 1044 birds, was 142:100. The first territorial birds were noted in late May.

Several writers, including Wetmore (1920), Bailey (1919), and Kortright (1943), have described the courtship performance. Territorial defense actions, observed from June 13 through July, were similar to those described by Bent (1925) under courtship activities.

Mergus merganser. Common Merganser.—Courtship was observed on four occasions, between February 24 and March 11. Copulation was witnessed on March 7. Most birds were paired by mid-March, but actual pairing was never evident. Sex-ratios changed greatly as the season progressed. The ratio for the entire period of migration, based on 615 birds was 161:100. The ratio for the period from February 15 to March 28 (479 birds) was 228:100, and for the period from March 29 to May 16 (136 birds) it was 51:100. This probably is due to differential migrations of sexes and ages. Young males of this species may be easily mistaken for females.

My observations of the courtship are similar to those of Townsend (1916). Courtship was carried out on Potholes Reservoir, sometimes far from shore. This, added to

the wariness of the species, made observations difficult. On one occasion it was possible to drift in a boat near a courting party, in line with the setting sun. Four males and one female were in the nearest group. The males swam rapidly past the female, tails slightly raised and spread (fig. 2D, left foreground). A throaty, gargling noise was given, which Townsend (1916) attributed to the male, but which seemed to me to be emitted by the female. The female was aggressive toward the males, jabbing the nearest with her needle-like bill (fig. 2D, center foreground).

Males of this species, as well as of most others, spend considerable time preening. Usually they lie on their sides, and display their brightly colored feet and immaculate undersides to the nearest female (fig. 2D, left background).

On one occasion courting birds were observed at a great distance. Several males flew toward a female, landing and skidding over the water for 20 to 30 feet (fig. 2D, right foreground), ending the run with a dive. The procedure resembled the courtship of the Western Grebe (*Aechmophorus occidentalis*), and the angle of the body suggested that the bird's feet probably are similarly used to propel the body forward.

The actions during and following copulation were similar to those described for Mallards.

LITERATURE CITED

- Audubon, J. J.
1840. The birds of America (New York and Philadelphia), 256 pp.
- Bailey, F. M.
1919. A return to the Dakota lake region. Condor, 21:3-11.
- Bennett, L.
1938. The blue-winged teal. Its ecology and management (Aimes, Iowa, Collegiate Press Inc.), 144 pp.
- Bent, A. C.
1923. Life histories of North American wild fowl, order *Anseres* (Part 1). Bull. U. S. Nat. Mus., 126:1-250.
1925. Life histories of North American wild fowl, order *Anseres* (Part 2). Bull. U. S. Nat. Mus., 130:1-376.
- Hochbaum, H. A.
1944. The canvasback on a prairie marsh (Baltimore, Md., The American Wildlife Institute), 201 pp.
- Kortright, F. H.
1942. The ducks, geese, and swans of North America (Washington, D. C., The American Wildlife Institute), 476 pp.
- Millais, J. G.
1902. The natural history of the British surface-feeding ducks (London), xiv + 107 pp.
- Munro, J. A.
1918. The Barrow golden-eye in the Okanagan Valley, in British Columbia. Condor, 20:3-5.
- Townsend, C. W.
1910. The courtship of the golden-eye and eider ducks. Auk, 27:177-181.
1916. The courtship of the merganser, mallard, black duck, baldpate, wood duck, and bufflehead. Auk, 33:9-17.
- Wetmore, A.
1920. Observations on the habits of birds at Lake Burford, New Mexico. Auk, 37:221-247.

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WOODPECKER CONCENTRATION IN BURNED FOREST

By JOHN L. BLACKFORD

On July 20, 1945, a fire in the Kootenai National Forest, previously controlled and held to twenty acres, broke out and swept an additional 660 acres of recovering, cut-over Douglas fir (*Pseudotsuga taxifolia*) and yellow pine (*Pinus ponderosa*) forest seven miles south of Libby in northwestern Montana. The area is chiefly low, valley benchland lying between Cherry and Libby creeks. Heavy timber had been cut from the valley levels, but such timber still was to be found on adjoining, partially logged hill and mountain slopes several miles distant. Young trees in this section were at once



Fig. 1. Fire damaged and borer infested Douglas fir south of Libby, Montana.

fire-killed. Larger, scattering 8- to 10-inch firs were so badly seared and scorched that most of them died the following season. Federal Highway No. 2 divides the burn.

Subsequent mass attack on the fire-damaged and weakened trees by boring beetles and their larvae, together with their extensive destruction in turn by a woodpecker "task force" drawn to the burn, soon became apparent. Notes and the accompanying photographs were taken in the first winter month following the fire. On three trips during November, 1945, I worked over about 60 acres, or approximately one-twelfth of the burned area, traversing one of the most heavily wooded parts of the burn and covering this same area west of the highway on each occasion. Although my interests were photographic, as accurate a count of the woodpecker population of this comparatively small section was made as circumstances permitted. Due to individuals flying swiftly from one portion of the area to another, moving from plots checked to others

not yet covered, exact count was lost in certain instances and approximations had to be made.

Numbers of Woodpeckers on 60 Acres of Recent Burn

	Nov. 20	Nov. 22	Nov. 25
Hairy Woodpecker (<i>Dendrocopos villosus</i>)	6	0	8-10
Black-backed Woodpecker (<i>Picoïdes arcticus</i>)	5	many, ± 20	± 12
Three-toed Woodpecker (<i>Picoïdes tridactylus</i>)	6	0	4
Red-shafted Flicker (<i>Colaptes cafer</i>)	0	1	1

Numbers were obviously greater over these wooded 60 acres than throughout the more open parts of the burn, but an overall high concentration was still indicated. Attraction of the woodpecker population from a sizeable portion of the surrounding country is inferred. The species listed are those most active and valuable in year-round control of insect outbreaks in destroyed coniferous forest of this region. The presence of so many Three-toed Woodpeckers (*Picoïdes tridactylus*), an uncommon species here, is of special interest.



Fig. 2. Thick layers of charred chips spread about base of Douglas fir, the result of woodpecker activity. Almost every tree in the burn received similar attention.

In connection with the foregoing it is interesting that for the first time in more than a dozen years no Hairy Woodpeckers were observed in the unburned woods about my former home, or at the feeding station there, throughout the winter of 1945-1946. Typically from three to four Hairy Woodpeckers are present in winter at that location, which is about eight miles north of the Cherry Creek burn.

Many questions for future investigation are suggested: What factors alert and bring woodpeckers in unusual numbers to a burned area from considerable distances? Does the absence of Hairy and Three-toed woodpeckers from this portion of the burn on November 22 indicate that each species is quite social under these conditions, and that each shifted as a group to some other part of the burn, then back again? Does the irregular, yet quite typical drilling and hewing pattern seen on all the Douglas fir boles represent an accurate outlining of larval dispersal beneath the thick, corky bark of these trees? If so, what may it tell us about tunneling habits of the bark borers, chief food source of *Dendrocopos* and *Picoïdes*?

On a succeeding trip to the burn on March 5, 1946, no woodpecker of any species was seen or heard; glasses were used to check superficially other sections not visited on foot. Trunks of practically all fire-blackened trees showed the same efficient and intensive pattern of bark-drilling and scaling that already marked the majority of them in November. It appeared that the woodpeckers had done a rapid "clean-up" job on these 680 acres and departed.

Libby, Montana, August 9, 1954.

BIRDS OF THE MONSERRATE AREA, CHIAPAS, MEXICO

By ERNEST P. EDWARDS and ROBERT B. LEA

The Lea-Edwards Expedition, with John W. Boehm of Elgin, Illinois, visited the Hacienda Monserrate in the state of Chiapas, México, in the spring of 1947, camping near the ranch house from March 24 to April 7. In the summer of 1950 Lea and Edwards with Douglas A. Lancaster and Virginia L. Lea returned to the Monserrate area and carried on field investigations from July 12 to August 17. In 1952, Edwards, with a field party consisting of J. Dan Webster, Arnold and Shirley Weinberg, and Stephen Russell, worked in the area from August 1 through August 10. Studies were made in an area measuring roughly six by ten miles, embracing both the mountain and plateau regions of southwestern Chiapas (see fig. 1). This paper is based on our collection of 705 specimens (106 spring; 599 summer), which represent 155 species. We have sight records of 29 additional species.

The Hacienda Monserrate, an extensive ranch owned by Xavier del Piño E., is situated in the district of Cintalapa among the mountains of southwestern Chiapas. It is approximately 10 miles east of the Oaxaca-Chiapas border and about 30 miles north of the Pacific Ocean. The main house, ranch buildings, corrals and homes of the workers on the hacienda are communally located on a sort of plateau, which, although rolling and deeply cut by streams, extends for about 15 miles to the south and a considerable distance to the east with little change in elevation. This comparatively flat land, on which are located several large haciendas, we call the Monserrate plateau. At the ranch house it reaches an elevation of 2200 feet. To the west and north of the ranch house, mountains rise steeply in nearly parallel ridges to an elevation of 5000 feet. The continental divide is, however, to the south; water draining from the vicinity of Monserrate flows into the Río Cintalapa, reaching eventually the Gulf of México.

Judging from faunal relationships, the Monserrate area appears to be divisible into the following zones:

- I. Arid Tropical Zone (2000-2500 feet)—Monserrate plateau.
 - A. Tropical Hardwood Forest—limited to the vicinity of streams on the plateau.
 - B. Semi-arid Scrub.
- II. Humid Upper Tropical Zone (4000-5000 feet).
 - A. Cloud Forest—occurred in a few humid ravines and on a few mountain ridges.
- III. Temperate Zone (2500-5000 feet).
 - A. Open Pine Forest (2500-5000 feet)—occurred on higher portions of the plateau and in the mountains.
 - B. Pine-oak Forest (3500-4500 feet)—occurred in the mountains.

ARID TROPICAL ZONE

In March and April the Monserrate plateau was a dry, semi-desert (fig. 2), whipped continuously by strong winds from the north and east. The weather was warm and sunny, except on March 25 when a light rain fell. Luxuriant vegetation was limited to the margins of the streams, where the tropical hardwood forest included *Mangifera indica*, *Licania* sp., *Inga spuria*, *Ficus* sp., *Psittacanthus schiedeana*, *Salix humboldtiana*, *Psidium* sp., and *Citrus* sp. Beyond the stream borders the flora was of a xerophytic nature. Extensive areas of dead grasses (*Paspalum notatum*) were studded with scattered thickets of various scrubby trees and shrubs, including *Acacia pennatula* and at least one other *Acacia*, and *Zanthoxylum fagara*. The soil was very dry and hard. Corn and bean fields, irrigated patches of sugar cane, and small garden plots were tended on

the plains near the rivers and on the higher ground that was well situated for irrigation. On the small ridges near the ranch house and on the rising land to the north and west, open grassy woods of *Pinus oöcarpa* began to replace the scattered *Acacia* and became more dense with increasing elevation.

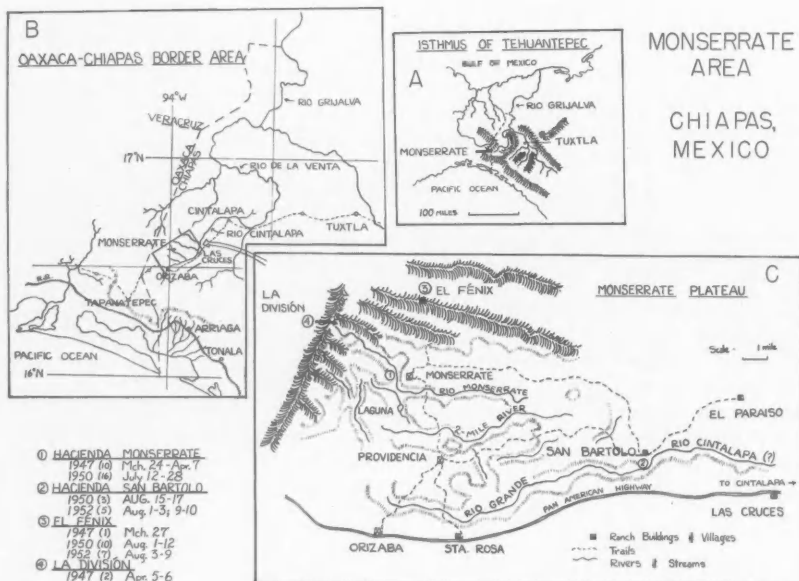


Fig. 1. Sketch maps of the Monserrate area, Chiapas, with inclusive dates of study for each locality.

During July and August the Monserrate plateau had a distinctly greener aspect. Rains were frequent and at times very heavy.

Our main collecting efforts on the plateau were directed along the three principal streams. The Río Monserrate originates in the mountains at La División and flows in a southeasterly direction across the plateau. In the spring it was a mere trickle through a boulder-strewn bed. In summer it was a clear, cold cascading stream which rose quickly with each torrential rain.

A mile south of the Monserrate ranch house there was a stream-fed *laguna* about one acre in extent, bordered by several acres of boggy, partly flooded land. Huge willows (*Salix humboldtiana*) dominated the vegetation in this area.

Two miles south of the ranch house a stream, which we called the "two-mile river," flowed west to east across the dirt road which led from Monserrate to the Pan-American Highway. The river had a wide, sandy bed, but it was never more than a small, shallow stream during our studies.

Still farther along, crossing the branch road about five miles south of the ranch house, was the largest river in the area. Its bed was 100 to 200 feet wide, and in places there was a broad flood plain, but it was only a few inches deep except after a hard rain. The river was known locally as the Río Grande, and we judged that it must have been one of the main tributaries of the Río Cintalapa.

Lizards were abundant on the plateau, where we collected specimens of *Cnemidophorus*, *Anolis*, *Basiliscus* and *Ctenosaura*. We often saw the toad *Bufo horribilis*, as well as *Rana pipiens*. We found *Boa constrictor* on the plateau and saw a specimen from the mountains. We saw no wild mammals on the plateau except *Odocoileus virginianus*, *Urocyon cinereoargenteus*, and the bat *Artibeus jamaicensis*. Cattle and horses ranged over the plateau and the pine-covered hillsides.



Fig. 2. Vegetation and topography near the edge of the Monserrate Plateau, looking northwest.

Birds Characteristic of the Arid Tropical Zone at Monserrate

<i>Ortalis vetula poliocephala</i>	<i>Pitangus sulphuratus</i>
<i>Burhinus bistriatus bistriatus</i>	<i>Calocitta formosa pompata</i>
<i>Columba flavirostris flavirostris</i>	<i>Thryothorus pleurostictus acaciurum</i>
<i>Zenaida asiatica mearnsi</i>	<i>Mimus gilvus gracilis</i>
<i>Aratinga canicularis canicularis</i>	<i>Poliophtila albiloris vanrossemi</i>
<i>Piaya cayana thermophila</i>	<i>Cassidix melanicterus</i>
<i>Morococcyx erythropygus erythropygus</i>	<i>Tangavius aeneus</i>
<i>Amazilia violiceps violiceps</i>	<i>Icterus gularis gularis</i>
<i>Helimaster constantii leocadiae</i>	<i>Icterus pustulatus formosus</i>
<i>Trogon citreolus sumichrasti</i>	<i>Volatinia jacarina splendens</i>
<i>Momotus mexicanus saturatus</i>	<i>Aimophila ruficauda lawrencii</i>
<i>Tyrannus melancholicus chloronotus</i>	

HUMID UPPER TROPICAL ZONE

Cloud forest conditions existed locally in the ravines and along the crests of a few ridges. A sharp ridge at the source of the Río Monserrate separated two stream systems north of the hacienda and was therefore called La División by the hacienda residents.

In the ravines on the north side of the ridge dense undergrowth occurred in a forest dominated by *Liquidambar styraciflua*.

El Fénix was an overgrown coffee plantation in a valley near the crest of the highest mountain ridge north of the Hacienda Monserrate. A small stream zigzagged through the valley where verdant undergrowth crowded the narrow bottomland. Like phalanges, a number of tiny tributary streams cut through steep-sided ravines, isolating a series of sharp ridges. Large deciduous trees, including *Liquidambar*, formed an umbrella over the ravines, where ferns, mosses, vines and such broad-leaved shrubs as *Hoffmania excelsa* grew in profusion. On a few of the higher ridges above the valley deciduous trees and shrubs grew in dense stands and supported an abundant epiphytic flora. Clouds hung low over this area much of the time. Yet we found scattered ridges where *Pinus oöcarpa* grew in open stands with almost no undergrowth or epiphytes.

Butterflies of the genus *Morpho* were common in the cloud forest. On one occasion Edwards watched a pack of about 50 adult and young *Nasua* rooting through the humus and fallen leaves.

Upon our return in 1952 the cloud forest had been partly opened up by removal of the big *Liquidambar*, and by construction of lumber roads. We found that the characteristic birds were still present in spite of this change, except *Pharomachrus*.

Birds Characteristic of the Humid Upper Tropical Zone at El Fénix

<i>Odontophorus guttatus</i>	<i>Empidonax flavescens dwighti</i>
<i>Geotrygon albigacies anthonyi</i>	<i>Henicorhina leucosticta prostheleuca</i>
<i>Pharomachrus mocino mocino</i>	<i>Turdus assimilis</i>
<i>Trogon collaris puella</i>	<i>Myadestes obscurus oberholseri</i>
<i>Momotus momota lessonii</i>	<i>Myadestes unicolor unicolor</i>
<i>Aulacorhynchus prasinus prasinus</i>	<i>Catharus mexicanus mexicanus</i>
<i>Xiphorhynchus erythropygius erythropygius</i>	<i>Myioborus miniatus intermedius</i>
<i>Lepidocolaptes affinis affinis</i>	<i>Basileuterus culicivorus culicivorus</i>
<i>Dendrocincla homochroa homochroa</i>	<i>Piranga leucoptera leucoptera</i>
<i>Anabacerthia striaticollis variegaticeps</i>	<i>Chlorospingus ophthalmicus ophthalmicus</i>
<i>Sclerurus mexicanus mexicanus</i>	<i>Atlapetes brunnei-nucha brunnei-nucha</i>
<i>Grallaria guatemalensis guatemalensis</i>	

TEMPERATE ZONE

The transition from the Arid Tropical Zone on the plateau to the Temperate Zone in the mountains was gradual. Scattered pine trees on the higher portions of the plateau gradually merged into an open forest of *Pinus oöcarpa* on the mountain slopes (fig. 3). Above 4500 feet *Quercus pilicaulis* became abundant and in some areas was the dominant tree. Mixed pine-oak woodlands were prominent in the high country near El Fénix. In some areas the oaks were heavily laden with epiphytic plants (fig. 4). The undergrowth in these mountain forests was mainly grass (*Sporobolus* sp.), although various shrubs and herbaceous plants including *Alnus*, *Aspilula purpurea* and *Lobelia* were abundant along the small mountain streams. On some high ridges the undergrowth consisted of dense masses of flowering thorny legumes, where hummingbirds fed in large numbers.

The weather in the Temperate Zone was generally cool and clear with scattered showers in the late afternoon almost every day in summer. One heavy rain fell in August. We collected several frogs (*Eleutherodactylus*) along the streams and saw many small lizards and occasionally a *Thamnophis* sp. We saw one pack of about 15 peccaries and noted *Odocoileus virginianus* infrequently.

Birds Characteristic of the Temperate Zone

Buteo jamaicensis costaricensis
Cyrtonyx ocellatus ocellatus
Columba fasciata fasciata
Colibri thalassinus thalassinus
Hylocharis leucotis leucotis
Eugenes fulgens viridiceps
Tilmatura dupontii dupontii
Melanerpes formicivorus lineatus

Dendrocopos villosus sanctorum
Contopus pertinax
Vireo solitarius montanus
Dendroica graciae ornata
Setophaga picta guatemalae
Loxia curvirostra mesamericana
Aimophila rufescens rufescens

The ranges of some of the Temperate Zone species were less clearly circumscribed than those of the Arid Tropical and Humid Upper Tropical species. We encountered *Melanerpes formicivorus* from the edge of the stream vegetation near the ranch house



Fig. 3. Edge of grassy, open pine woodland on lower mountain slopes.

all the way up through the pine woods to the high ridges at La División and El Fénix. *Dendroica graciae* was common in the dry upland thickets and in the pine-oak woods.

We observed also a number of tropical species which occurred regularly in more than one of the three zones which we have considered. Some of these were:

Aratinga holochlora holochlora
Dryocopus lineatus similis
Amazilia cyanocephala cyanocephala
Myiodynastes luteiventris luteiventris

Chloroceryle americana vanrossemi
Turdus grayi
Piculus rubiginosus maximus
Piranga flava dextra

Because the Isthmus of Tehuantepec affords, for lowland forms, a break through mountain barriers, while acting as a barrier itself to highland forms, it is to be expected that a complex situation would exist in an area bordering the isthmus. This is true at

Monserate where Atlantic and Pacific lowland forms intermingle, and where highland forms show closest affinities to those of Central America.

The fauna of eastern México has easy access to the Monserate area through the Río Grijalva system and is represented there by 19 forms. Birds generally considered to be Pacific lowland forms would be able to cross over to the Atlantic slope at elevations slightly above 1000 feet at the isthmus, or at elevations slightly above 3000 feet where numerous passes cut through the mountains farther to the east. That a consider-



Fig. 4. Dense growth of epiphytes on *Quercus pilicaulus* in pine-oak woods at 4500 feet elevation.

able infiltration of Pacific forms has occurred is demonstrated by the presence of *Ortalis vetula poliocephala*, *Trogon citreolus sumichrasti*, *Momotus mexicanus saturatus*, and *Cassiculus melanicterus* of western México, as well as *Burhinus bistriatus bistriatus*, *Aratinga canicularis canicularis*, *Morococcyx erythropygus erythropygus*, *Xanthoura yncas vivida*, *Tanagra affinis affinis*, and *Saltator atriceps peeti* which occur on the Pacific slope farther southeast. Some birds from Monserate which show intermediacy between Mexican and Central American subspecies are *Cyclarhis gujanensis*, *Chamaethlypis poliocephala*, and *Icterus gularis*. Relationship with the mountain fauna of Veracruz is shown by the presence of *Chlorospingus ophthalmicus ophthalmicus*, but

most other birds of the Temperate and Humid Upper Tropical zones are of wide-ranging forms or else belong to Central American subspecies.

Both in spring and summer we encountered North American transients in every type of habitat, although they were noticeably less common in the damp deciduous forests at La División and El Fénix. Most numerous of all were the wood warblers, especially near the lowland streams in March and April and in the pine-oak woods in August. Several species of fringillids moved about on the plateau in the spring, flocks of *Passerina cyanea* and *Chondestes grammacus* being the most conspicuous. Flycatchers were the most widely distributed of the transients; we encountered migrating empidonacines daily in March and April, and in August, in approximately equal numbers, from the stream bottoms up to the cloud forest.

Nesting activity undoubtedly reached its peak in May and June in the Monserrate area. It was surprising that even in this extreme southern portion of México we found the nests of only six species in March and April, namely *Buteogallus anthracinus*, *Myiozetetes similis*, *Pitangus sulphuratus*, *Corvus corax*, *Calocitta formosa*, and *Thryothorus pleurostictus*. Several other species were in breeding condition, but relatively few birds were singing persistently. Many species which we expected to find nesting were still moving about in flocks. Many specimens that we collected were in the prenuptial molt. In July and August nesting had been nearly completed. Twelve species were nesting, and many others moved about in family groups and fed young out of the nest.

A hawk not previously known in México is *Accipiter chionogaster*. The Central American subspecies, *montanus*, of *Vireo solitarius* has not previously been recorded in México. New records for the state of Chiapas include *Chaetura vauxi tamaulipensis*, *Dendrocincla homochroa*, *Nuttallornis borealis*, *Dendroica chrysoparia*, and *Chlorospingus ophthalmicus ophthalmicus*.

We are indebted to many persons in addition to members of the field parties for assistance throughout the course of this project. Among these are Dr. John Aldrich, Mr. Emmett Blake, Dr. Pierce Brodkorb, Dr. Robert Clausen, Dr. Herbert Friedmann, Dr. Norman Hartweg, Ing. Luis Macías, Dr. Rogers McVaugh, Don Xavier del Piño, Dr. George Sutton, and Dr. Josselyn Van Tyne.

In addition to the species which we collected, which are discussed in the systematic list, we observed the following 29 species:

Podilymbus podiceps, *Ardea herodias*, *Casmerodius albus*, *Heterocnus mexicanus*, *Mycteria americana*, *Cairina moschata*, *Anas discors*, *Sarcoramphus papa*, *Coragyps atratus*, *Cathartes aura*, *Buteo swainsoni*, *Buteo magnirostris*, *Circus cyaneus*, *Caracara cheriway*, *Falco sparverius*, *Penelopina nigra*, *Zenaidura macroura*, *Caprimulgus vociferus*, *Aëronautas saxatalis*, *Sphyrapicus varius*, *Tyrannus vociferans*, *Stelgidopteryx ruficollis*, *Hirundo rustica*, *Corvus corax*, *Bombicilla cedrorum*, *Peucedramus taeniatus*, *Piranga ludoviciana*, *Spinus psaltria*, *Chondestes grammacus*.

SYSTEMATIC LIST

Specimens used in comparing our collection are located in the following museums: Museum of Zoology, University of Michigan; Chicago Natural History Museum; United States National Museum. Somewhat shortened designations in the text refer to these institutions.

Crypturellus cinnamomeus. Rufescent Tinamou. 3 ♂♂, August 4-16. We recorded this species rarely. Edwards saw a whistling adult accompanied by one small chick at El Fénix on August 3. The two specimens from the humid forest are *soconuscensis*, while the specimen from the plateau is the much paler *vicinior*.

Chondroheirax uncinatus. Hook-billed Kite. 1 ♂, July 22. This specimen was taken by Lea in dense woodland along the Río Grande. The skin on the face was greenish; the irides were pale gray. It is an example of the melanistic phase which we cannot place subspecifically.

Accipiter chionogaster chionogaster. White-chested Hawk. 1 ♀, 1 ♀ im., July 23, August 6. The adult, carrying a dead immature *Tityra*, was taken just after it flew up from the bed of a small stream in the mountains. The young bird was in a group of four fledglings. These specimens represent the first records of this hawk from México. The nearest previously reported locality is apparently Tecpam, Guatemala (Hellmayr and Conover, 1949:74). Our specimens are more streaked below than all but one *chionogaster* in the collection of the Chicago Natural History Museum. That one, an adult male, is streaked somewhat more extensively than our adult female but is similar to it in showing a very faint suggestion of barring on the sides of the chest. The palest specimens of *Accipiter chionogaster ventralis* are as little streaked below as our birds, but they have much darker tibial feathers. [This hawk is considered by Storer (Condor, 54, 1952:289) to be a race of the Sharp-shinned Hawk, *Accipiter striatus*.—Editor.]

Buteo albicaudatus hypospodius. White-tailed Hawk. 1 ♂, March 29. We observed two pairs occasionally, from March 26 to April 3. One pair frequented the laguna area. In July and August we noted one to three birds in the plateau area, and one at El Fénix.

Buteo jamaicensis costaricensis. Red-tailed Hawk. 1 ♀, August 11. One or two noted occasionally over the plateau and at El Fénix in spring and summer. Our specimen is a rufescent example of *costaricensis*.

Buteo nitidus. Gray Hawk. 2 ♂ ♂, 2 ♀ ♀ im., March 26–August 15. This was the most common *Buteo* in the plateau area. Edwards saw a pair copulating on March 30, and on the same day he observed an adult soaring overhead with an individual in subadult plumage. Because of the great overlapping of wing and tail measurements and the considerable variation in amount of tail barring and darkness of underparts we prefer not to recognize *maximus* nor *micrus* and thereby follow Hellmayr and Conover (1949:157).

Buteogallus anthracinus. Common Black Hawk. 1 ♀, 1 ♀ juv., April 4, July 28. We encountered this hawk almost daily along the Río Monserrate and at the laguna. We saw a single adult near El Fénix on August 6 and 7. An occupied nest (March 26) in a tree along the Río Monserrate was composed of sticks placed on a horizontal crotch of a limb about 40 feet above the ground. On the occasion of the original discovery the adult birds flew about and screamed loudly. On subsequent visits to the nest we found that the bird in attendance remained quietly on the nest, or, as on April 2, both adults soared calmly at a considerable distance overhead. We did not determine the contents of the nest, but the adults appeared to be incubating. The female, when collected, had a crayfish and small mammal remains in its gizzard.

On July 16, Lea found a nest which contained one young bird (fig. 5). The nest was about 50 feet above the ground in a willow tree at the laguna. It was a rough platform nest composed of sticks and entwined with living vines on a horizontal crotch about eight feet from the main tree trunk. The slightly concave platform was approximately three feet in diameter and two feet thick. Two adults were active in the vicinity but we saw only one adult at the nest at any one time. On three occasions we saw a parent bird bring food to the nest; once the food item was a large lizard.

It seems to us that Hellmayr and Conover (1949) are correct in recognizing no subspecies of this species.

Geranospiza nigra. Black Crane-Hawk. 1 ♀, August 10. Collected at the Río Grande; this specimen had bright orange eyes.

Herpetotheres cachinnans cachinnans. Laughing Falcon. 1 ♀, July 25. Lea collected the only individual recorded, in a low pine tree on the plateau near the Río Monserrate. The specimen does not differ in any marked degree from Brazilian specimens. We agree with Hellmayr and Conover (1949:237) that *chapmani* should be combined with *cachinnans*.

Penelope purpurascens purpurascens. Crested Guan. 1 ♀, 2 ♀ ♀ im., 1 ♀ juv., August 2–6. Edwards saw two guans in the sweet gum forests at La División on April 5. We saw and heard this species frequently in the wet forests at El Fénix in August. They moved about in large trees in groups of two to five. The birds were very noisy, and sometimes stupidly curious, coming within 30 feet of us to peer down, stretching their long necks, and then standing erect with crests raised and bare red throat areas prominent.

Ortalis vetula poliocephala. Plain Chachalaca. 1 ♂, 1 ♀, July 25, March 26. In March and April we saw or heard this species almost every day that we worked in the plateau area, particularly along the streams. In July and August we saw individuals much less frequently and heard them call only

twice. The female specimen was compared with the type of *vallicola*. Our bird is distinctly larger, paler on the belly, and more buffy on the crissum and tail. The tips of the rectrices are considerably more buffy, and this tipping is about 50 mm. in length, as compared with 15 to 20 mm. on *vallicola*.

Colinus virginianus insignis. Bob-white. 7 ♂♂, 4 ♀♀, March 29–August 9. We saw coveys of four to six birds almost daily from March 26 to April 1 in the grasslands on the Monserrate plateau. These birds were all adults and did not call. In July and August pairs were common, and many males were calling daily. On July 25 Lea flushed an adult female with her brood of about a dozen chicks. The female taken on July 26 had a shelled egg in her oviduct.



Fig. 5. Young of Common Black Hawk on nest in large willow.

We have compared our birds with the material in the University of Michigan Museum, the National Museum, and the Conover collection at the Chicago Museum. They agree well with series of *insignis*. They are less rufous on the back than *coyolcos* and do not show the extensive black markings on the chest characteristic of that subspecies. Our specimens show several variations from white superciliary and malar streak to all black head. Partly for this reason we believe that *nelsoni* will prove to be a synonym of *insignis*.

Odontophorus guttatus. Spotted Quail. 2 ♂♂, 1 ♂ juv., 4 ♀♀, April 5–August 9. Edwards surprised a group of several birds in the undergrowth on the north side of La División on April 5. They ran rapidly, holding their crests erect and calling excitedly, and flew only when hard pressed. In August we noted the species frequently at El Fénix in the cloud forest, where they behaved in a similar manner.

Individuals showing the supposed characters of *matudae* occur in the same locality as individuals which appear to be typical *guttatus*. One of our specimens combines narrow shaft streaks on the throat with the typical tear-shaped markings on the breast feathers of supposed *matudae*.

Dactylortyx thoracicus. Long-toed Quail. 2 ♂♂, 2 ♀♀, 1 ♂ juv., 1 ♀ juv., August 5–7. Noted only once in 1950, this species seemed fairly common in 1952. We saw several family groups and heard birds calling almost daily at El Fénix. Subspecific placement is doubtful until the relationships are studied further.

Cyrtonyx ocellatus. Ocellated Quail. 1 ♀ im., 1 ju. (sex ?), August 11-13. We often flushed coveys of this quail in the grassy pine-oak woods near El Fénix.

Tringa solitaria cinnamomea. Solitary Sandpiper. 1 ♂, March 30. We saw two at the "two-mile river" on March 28 and 30, and one at the Rio Grande on March 31.

Actitis macularia. Spotted Sandpiper. 1 ♂, August 16. We noted one or two Spotted Sandpipers along the Rio Grande on March 30 and August 15 to 17.



Fig. 6. Mexican Thick-knee, a common but shy nocturnal bird of the plateau.

Burhinus bistriatus bistriatus. Mexican Thick-knee. 1 ♀, August 16. In March and April we often heard the Alcaraván, as the Mexicans call this species (fig. 6), at night in the pastures and cultivated fields, and along the irrigation ditches on the Monserrate plateau, but we never saw or heard them between dawn and dusk. They commenced calling, a loud "barking," somewhat like the call of a Sandhill Crane, in the twilight after sundown, their night activity increasing as the moon waxed. They spent most of the time on the ground, although when disturbed they usually took wing, often flying half a mile or more before alighting. Sometimes their flight was low and erratic, not carrying them above the skyline. Thus in the twilight the birds could scarcely be discerned. A bird which Lea pursued one night screamed loudly as it ran along an erratic course, sometimes taking wing for a low flight over the mesquite, or running up and over low bushes as though ascending a flight of stairs three steps at a time.

In July and August the birds called irregularly and infrequently. Lea and a party of Mexicans collected one of a pair in short grass near some ranch buildings. This female ran swiftly and then stood still in the headlights of the jeep, pointing head and tail in a horizontal crouch.

Columba flavirostris flavirostris. Red-billed Pigeon. 2 ♂ ♂, 1 ♀, July 21-August 16. Encountered often in small flocks in March, April, July, and August along or near the rivers of the plateau country. No nesting activity was observed.

Columba fasciata fasciata. Band-tailed Pigeon. 1 ♀, August 3. We saw this species occasionally in the pine-oak woods near El Fénix in August.

Zenaida asiatica mearnsi. White-winged Dove. 3 ♂ ♂, 2 ♂ ♂ im., July 13-August 15. Second in

abundance to *Scardafella inca* among the doves on the plateau. All specimens are well within the size range of *mearnsi*, and the only one in fully adult plumage agrees with that subspecies in coloration.

Scardafella inca. Inca Dove. 3 ♂♂, 1 ♀, March 31–July 25. The most abundant dove at Monserrate. We saw it every day on the plateau, feeding in small flocks in the barnyards and around dwellings, or in the fields and pasturelands.

Columbigallina passerina pallescens. Ground Dove. 2 ♂♂, 3 ♀♀, 1 (sex ?). Common along the roads and streams of the plateau.

Claravis pretiosa. Blue Ground Dove. 1 ♂, 1 ♂ im., July 21. Although seldom seen, individuals were frequently heard calling in August.

Leptotila verreauxi angelica. White-fronted Dove. 3 ♂♂, 1 ♂ im., 4 ♀♀, March 29–August 9. We saw individuals occasionally in woodland along the rivers on the plateau and somewhat more frequently on the lower slopes of the mountain ridges and in the high humid forest. Although the two females from La División and El Fénix look like *bangsi*, the male from El Fénix is typically *angelica*.

Geotrygon albigacies anthonyi. White-faced Quail-Dove. 2 ♂♂, 1 ♀, August 6–11. This species inhabited the humid forest. Individuals seemed to feed alone, and when disturbed they quickly flew out of sight in the undergrowth.

Aratinga holochlora holochlora. Green Parakeet. 2 ♂♂, 3 ♀♀, March 29–July 22. Common on the plateau in March. The screeching flocks became even larger and more noisy in early April as they moved into *Mimosa* trees to feed on the developing seeds. In July and August flocks of as many as 50 birds were seen daily on the plateau. We saw them occasionally in small numbers at La División and El Fénix. Our specimens are too small to be *strenua*.

Aratinga canicularis canicularis. Orange-fronted Parakeet. 4 ♂♂, 3 ♀♀, July 17–August 10. Lea saw six of these parakeets at the "two-mile river" on March 30. In July and August they were common on the plateau, ranging in flocks of as many as 50 birds, but they never were as abundant as *A. holochlora*. We did not see them at El Fénix.

Three of our specimens show the broad band of orange which is typical of the nominate race, whereas the others show less orange. One can be matched in amount of orange by some *eburnirostrum*. The taxonomic situation seems to us not as simple as Bangs and Peters (1928:388–389) indicated in characterizing *canicularis* as a broad-banded, yellowish-bellied race and *eburnirostrum* as a narrow-banded, greenish-bellied race. There seems to be little, if any, difference in yellowness of belly between the two subspecies, and some individuals could not be correctly placed on the basis of width of the orange band.

Pionus senilis senilis. White-crowned Parrot. 1 ♀, August 10. We occasionally saw flocks of 10 to 20 birds in the pine-oak woods and cloud forest at El Fénix in August.

Amazona autumnalis autumnalis. Yellow-checked Parrot. 1 ♂, 2 ♀♀, March 29–August 16. In March and April we saw this species almost daily along the rivers on the plateau and at La División in flocks numbering up to six birds. It seemed considerably less numerous in July and August. Our specimens are small *autumnalis*, the March female tending toward *salvini* in narrowness of the orbital band of yellow.

Piaya cayana thermophila. Squirrel Cuckoo. 4 ♂♂, 3 ♀♀, March 28–August 16. We saw this species occasionally along the plateau rivers, as well as once at El Fénix and once at La División.

Crotophaga sulcirostris sulcirostris. Groove-billed Ani. 3 ♂♂, 4 ♀♀, April 1–July 27. Common in the dry thickets near the streams on the plateau in March, April, July, and August. We watched adults feeding fledglings on several occasions from July 21 to 27, and we saw an adult in a flimsy stick nest on July 27.

Morococcyx erythropygus erythropygus. Lesser Ground Cuckoo. 1 ♀, 1 ♂ im., July 25, August 15. Recorded only twice, when Lancaster collected a female in burned-over brush near the "two-mile river" and Lea took a young male in dense growth along the Rio Grande.

Our specimens are darker than *mexicanus* and show the belly color characters attributed to *erythropygus* by van Rossem (1938:170). However, the tail characters do not follow the pattern indicated by him. The feathers, although new, do not show a strongly contrasting pattern, and in this respect show a tendency toward those of *mexicanus*. In addition the specimens show a tendency toward *mexicanus* or *macrourus* in having very long tails.

Geococcyx velox melanchima. Lesser Road-runner. 3 ♂♂, 2 ♀♀, April 2–July 26. Recorded

occasionally in spring and summer on the plateau. We also saw it three times in the high, dry pine woods near El Fénix in August. The female taken on April 2 was in breeding condition.

Following Moore's (1934:455-470) analysis of the species we place our birds with *melanchima* on the basis of (1) absence of gray on the second rectrix, and (2) broad subterminal black bar on the lateral rectrix. Two male and two female specimens show some intergradation toward *affinis* in the following respects: (1) one male has a subterminal black bar which measures 13 mm. on the left lateral rectrix and 10 mm. on the right, (2) another male has a slight marbling of gray (almost entirely away from the shaft) on the second rectrix, and (3) the females are large. In the other characters listed by Moore in separating *melanchima* and *affinis* the measurements of our specimens overlap those of both subspecies.

Tyto alba pratincola. Barn Owl. 1 ♂, August 17. This specimen was captured in an old barn by natives, who reported finding the species occasionally about the ranch buildings.

Glaucidium brasilianum ridgwayi. Ferruginous Pygmy Owl. 4 ♂ ♂, 3 ♀ ♀, March 30-August 15. We heard this owl calling in the early morning, at night, and occasionally through the day in March and April, but much less frequently in July and August. We did not record the species at La División or El Fénix. Lea saw three of them together near the Río Grande on March 30. One was feeding on a small mammal. When it flew it carried the food in its talons. Our specimens represent both rufous and brown phases and fall well within the size limits of this race.

Chordeiles acutipennis micromeris. Lesser Nighthawk. 1 ♀, July 21. This specimen, taken by Lancaster, is our only record. It is too small for *texensis*, but fresh material is needed to confirm assignment of birds of this area to *micromeris*.

Nyctidromus albicollis yucatanensis. Pauraque. 3 ♂ ♂, 4 ♀ ♀, March 29-July 27. Calling and night activity of this species increased as the moon waxed in the spring, and during the bright moonlight nights of April 1 to 5 Pauragues were calling in great numbers on the Monserrate plateau. In July we flushed one occasionally at the laguna in the day time and along the roads at night, but we seldom heard them calling.

Our birds fit well with *yucatanensis* in most respects, although in small size they show a strong tendency toward the Central American race *intercedens*.

Streptoprocne zonaris mexicana. White-collared Swift. 1 ♂, July 13. Edwards collected one of about 40 that circled over a cornfield on the plateau, and on July 16 he saw another over our Monserrate camp.

Chaetura vauxi tamaulipensis. Vaux Swift. 1 ♂, July 13. We noted a few small, dark swifts in the high country on March 27 and April 5. In July and August we saw them almost daily over the plateau and at El Fénix, singly or in groups of as many as 50 individuals.

The specimen taken resembles *tamaulipensis* closely, is quite different from *richmondi*, and is slightly less blackish (more brown) than a large series of *gaumeri* in the National Museum collection. It cannot be definitely established that our specimen represents the breeding population, but we suspect that *tamaulipensis* ranges more widely than known heretofore. It has not previously been reported from Chiapas.

Colibri thalassinus thalassinus. Violet-eared Hummingbird. 1 ♂, August 6. Lea collected this specimen in a thicket in the pine-oak woods. It corresponds with *thalassinus* in size and thickness of bill, tending somewhat toward *minor* in reduction of blue on the chest.

Hylocharis leucotis leucotis. White-eared Hummingbird. 6 ♂ ♂, 1 ♂ im., 1 ♀ (?) im., April 5-August 10. This species was second in abundance to the following hummer in the highland pine and pine-oak woods.

Amazilia cyanocephala cyanocephala. Azure-crowned Hummingbird. 7 ♂ ♂, 3 ♀ ♀, March 25-August 6. We found this species to be the most abundant hummingbird both on the plateau and in the pine woods of the high mountains.

Amazilia violiceps violiceps. Violet-crowned Hummingbird. 3 ♂ ♂, 3 ♀ ♀, 2 im. (sex?), March 25-August 3. We saw this species frequently along the rivers and at the laguna in the spring and summer.

We find that the more iridescent green back is the best way of distinguishing the subspecies *violiceps* from other forms. Our specimens are dark greenish blue on the crown, as in the "*guerrerensis*" or *viridifrons* stage mentioned by Griscom (1934:376). All of the more than 20 specimens of *violiceps* from western México in the Chicago Museum collection have iridescent blue crowns, whereas all our specimens and the one Chiapas bird in the collection have dark crowns without iridescence. In addi-

tion, our specimens and the aforementioned Chiapas bird are bronzy green backed, whereas birds from western México (*elliotti*) are dull brownish on the back.

Lampornis viridi-pallens viridi-pallens. Green-throated Mountain Gem. 1 ♂, 2 ♀ ♀, 1 (sex?), August 5-11. Recorded infrequently at El Fénix, where Edwards collected the specimens in humid forest. They do not differ from typical *viridi-pallens* from Guatemala, except that they are more brassy above.

Eugenes fulgens viridiceps. Rivoli Hummingbird. 5 ♂ ♂, 1 ♂ im., August 5-10. We noted this species occasionally among the thorny legumes in the high pine woods in August. Our specimens have the long culmen (28-29 mm.) of the Guatemalan subspecies.

Heliomaster constantii leocadae. Plain-capped Star-throat. 3 ♂ ♂, 1 ♀, April 2, August 2. Recorded only on the plateau.

Tilmatura dupontii dupontii. Swallow-tailed Hummingbird. 1 ♂, 2 ♂ im., 2 ♀ ♀, August 5-10. We saw several flying about the thorny legumes in the pine woods near El Fénix. That the width of the chestnut tail band varies considerably is demonstrated by two of our male specimens with bands which measure, respectively, 2.5 and 7.0 mm.

Archilochus colubris. Ruby-throated Hummingbird. 1 ♀, March 29. We recorded this transient species only on this date.

Pharomachrus mocino mocino. Quetzal. 1 ♀, August 11. We looked for this bird in vain in 1947, and upon our return in 1950 we made it the object of intensive search. Lea saw a single female in the dense cloud forest at El Fénix on August 5, 8, and 10. On August 11 we watched three Quetzals which appeared to be a family group moving about warily in the tree tops. We did not see a fully adult male. An engineer told us of shooting a long-plumed Quetzal at El Fénix in June.

Trogon citreolus sumichrasti. Citreoline Trogon. 2 ♂ ♂, 1 ♀, 1 ♀ im., March 30-August 15. We saw one or two birds infrequently, and sometimes heard them calling, in the heavy riverside growth on the plateau in March and April. They called less frequently in July and August.

Our March specimen agrees generally with the type and a series of *sumichrasti* in the Michigan Museum collection, although it is in fresher plumage and shows much brighter yellow on the abdomen. The summer specimens (except the adult female), even in their extremely worn condition, show a greater extent of white tipping on the outer rectrix than does the nominate subspecies.

Trogon collaris puella. Collared Trogon. 4 ♂ ♂, 4 ♀ ♀, April 5-August 15. Fairly common in the humid forests. Most of the birds that we saw in April seemed to be paired.

Trogon violaceus braccatus. Violaceous Trogon. 1 ♂, 2 ♀ ♀, July 22-August 15. We recorded this species infrequently on the plateau and at El Fénix in the summer.

Chloroceryle americana vanrossemi. Green Kingfisher. 2 ♂ ♂, 2 ♀ ♀, 2 ♂ im., 1 ♀ im., March 26-August 16. We saw one or two individuals of this species almost daily along the streams on the plateau and at El Fénix. Our adult male specimens are especially large. We compared our specimens with the type and a good series of *vanrossemi* in the Michigan Museum collection and a series of *septentrionalis* in the Chicago Museum and assigned them to *vanrossemi* on the basis of their large size, the restricted amount of green spotting on the underparts, and the smallness of the green sub-malar streak.

Momotus mexicanus saturatus. Russet-crowned Motmot. 4 ♂ ♂, 2 ♀ ♀, 1 ♀ juv., March 30-August 15. We saw them almost daily along the rivers on the plateau. They called much more often in the summer than in the spring. In July we occasionally saw family groups with non-racket-tailed birds among them. On April 5 Lea saw one bird in the sweet gum forest at La División, rather far from its usual habitat.

Momotus momota lessonii. Blue-crowned Motmot. 1 ♀, April 6. We observed individuals occasionally in the humid forests at La División and El Fénix in August. The central rectrices of the specimen are 65 mm. long, sheathed for about half their length, and completely invested with barbs.

Aulacorhynchus prasinus prasinus. Emerald Toucanet. 4 ♂ ♂, 5 ♀ ♀, April 6-August 11. We saw these birds occasionally in the humid forests in groups of two or three in April, and as many as 20 in August. They often sat motionless and called with repeated loud *wack . . wack . . wack . .* sounds. They seemed both curious and stupid.

Only two of our specimens, both females, are fully adult and suitable for comparison. They are closest to *prasinus* in color and one has the broad tomial stripe (5.5 mm.) of that subspecies, whereas

the other has a rather narrow stripe (4 mm.). They lack the golden tinged pileum, hindneck and upper back of *chiapensis*.

Picus rubiginosus maximus. Ruddy-green Woodpecker. 5 ♀ ♀, July 16–August 10. We saw this species infrequently on the plateau and in the pine-oak woods at El Fénix and La División.

Dryocopus lineatus similis. Lineated Woodpecker. 2 ♂ ♂, 1 ♀, April 1–July 23. We saw this woodpecker occasionally in the large trees along the waterways and in the open pine woods on the plateau. On August 3 Edwards saw a single bird in the deciduous forest at El Fénix.

The male taken in July is a good match for a series of near topotypes of *similis* in the Chicago Museum. The female shows a tendency toward *scapularis* in having a broken suborbital and subauricular stripe.

Melanerpes formicivorus lineatus. Acorn Woodpecker. 4 ♂ ♂, 2 ♀ ♀, 1 ♀ im., March 26–August 9. We saw this species occasionally in the open pine woods on the plateau. Although the male taken in spring had much enlarged testes, we observed no indications of nesting except that the birds were often paired. Near El Fénix the species was common. On August 10 and 11 we saw flocks of more than 50 individuals flying, feeding, chasing one another noisily and sidling back and forth on horizontal branches in the pine-oak woods.

Our specimens agree with a series of topotypical *lineatus* in the Chicago Museum, showing heavy striping below without a solid black chest band.

Centurus aurifrons. Golden-fronted Woodpecker. 5 ♂ ♂, 2 ♀ ♀, 1 ♀ (?), March 29–August 17. We saw this species frequently in all types of environment on the plateau. In March and April we watched them investigating nest holes in the palm trees around the ranch house and in the large willow trees at the laguna. Most frequently they were in pairs, and occasionally we observed them engaging in acrobatic feeding antics, swinging from small branches to pluck ripe fruit.

Compared with the series that Wetmore (1943:273–277) studied, our specimens appear to be intermediate between *frontalis* and *polygrammus*, but slightly closer to the former. They have wider black and white bars above than does *polygrammus* and more black markings on the rump and upper tail coverts. The shade of yellow on the abdomen seems pale, closer to that of *frontalis*.

Dendrocopos villosus sanctorum. Hairy Woodpecker. 2 ♂ ♂, 2 ♀ ♀, August 7–11. Noted infrequently in the pine-oak woods.

Dendrocopos scalaris percus. Ladder-backed Woodpecker. 1 ♂ im., 1 ♀, 1 ♀ im., July 16–23. On the plateau we saw individuals occasionally. Edwards saw one at La División on April 5. In breast spotting and back striping our specimens agree closely with the type of *percus*. They differ little from *parvus* in color and the immature specimens do not exceed *parvus* in size, but the adult female is definitely larger. Our specimens show no tendency toward the tail pattern of *azelus*.

Phloeocastes guatemalensis. Guatemalan Ivory-billed Woodpecker. 2 ♂ ♂, August 5–8. One to three birds noted together in the cloud forest. Our specimens appear to be well marked examples of two different subspecies, *guatemalensis* and *nelsoni*. This suggests that El Fénix may be in a narrow zone of intergradation between two forms. Further collecting is needed to show whether the local population is extremely variable.

Dendrocincla homochroa homochroa. Ruddy Woodhewer. 1 ♂, August 10. Taken by Lea amid dense undergrowth in the humid forest, this specimen apparently is the first known from Chiapas.

Sittasomus griseicapillus sylviooides. Olivaceous Woodhewer. 5 ♂ ♂, 1 ♀ (?), March 27–August 11. Noted occasionally in the humid forests at La División and El Fénix in March, April, and August.

Dendrocolaptes certhia sancti-thomae. Barred Woodhewer. 1 ♀, August 8.

Xiphorhynchus flavigaster eburneiostris. Ivory-billed Woodhewer. 3 ♂ ♂, April 5–August 4. We noted this species in the sweet gum forest at La División—one individual on April 5 and two on April 6. We saw it a few times at El Fénix.

Two of our specimens seem quite aberrant. They are closest to *eburneiostris*, but the ventral and dorsal spots and the throat lack the strong buffy tinge of those of *eburneiostris*, while the dark borders of the spots are much blacker than in that subspecies. Thus, in coloration they are blacker than any of the known subspecies. In large bill size the April specimen approaches *flavigaster*, but the bill of the August specimen is small and very dark. A male from Prusia, Chiapas, is close to our dark birds but is slightly buffier and quite small-billed, while a female from Prusia appears to be good *eburneiostris*, as does one of ours.

Xiphorhynchus erythropygius erythropygius. Spotted Woodhewer. 3 ♂ ♂, 1 ♂ im., 5 ♀ ♀, 1 ♀ im.,

April 6–August 11. The call of this species was a drawn out, piercing whistle, sliding down two tones in pitch. In August we saw small groups in the humid forest at El Fénix.

Lepidocolaptes affinis affinis. Spotted-crowned Woodhewer. 5 ♂♂, 1 ♂ im., 4 ♀♀, August 2–11. This was the most common woodhewer in the pine-oak woods and the humid forest at El Fénix in August.

Anabacerthia striaticollis variegaticeps. Scaly-throated Tree-hunter. 2 ♂♂, 1 ♂ (?), 1 ♀, April 5–August 11. We saw this bird infrequently in the humid forest at La División and El Fénix. The birds fed near the ends of the small branches most of the time, occasionally even hanging upside down.



Fig. 7. Nest and egg of Scaled Antpitta on a fallen log.

Sclerurus mexicanus mexicanus. Tawny-throated Leaf-scraper. 1 ♂, 1 ♀, 1 ♀ im., August 2–11. We saw this species infrequently at El Fénix, in the moist ravines. Its call was a sharp clear whistle. It apparently has been recorded previously from Chiapas only by Berlioz (1939:366) at Santa Rosa.

Thamnophilus doliatus intermedius. Barred Ant-Shrike. 1 ♂, April 6. Our specimen is pale below and tends toward *pacificus* in having very wide white stripes dorsally.

Grallaria guatemalensis guatemalensis. Scaled Antpitta. 2 ♂♂, 1 ♀, August 5–11. We saw this species rarely in the thick undergrowth at El Fénix. While cutting a trail through a thicket, Edwards found a nest on August 9. It was located near a small stream in a flat, overgrown parklike area between two sections of the rain forest. The nest was built on a nearly horizontal dead log which had fallen across a trail. It was in a small cleared niche in the tangle of undergrowth just two feet from where the old trail crossed the log. The nest was cup-shaped, supported principally by the log, but partly also by the entwined branches of shrubs which grew around it. It was composed of small sticks, dry pine needles, moss and dead leaves, with a partial lining of dead leaves and pine needles (fig. 7). The nest measured: outside diameter, 165 to 190 mm.; inside diameter, 100 to 115 mm.; depth of cup, 50 to 75 mm.; outside depth, 85 to 100 mm.; distance above ground, one meter. The nest contained a single pale blue, blunt-ended, slightly glossy egg.

Lea watched the female bird incubate. It approached the nest with extreme caution, like a rail, moving carefully down the log from the thicket to a position beside the nest. It then stepped up on the sides of the nest, straddled the egg, nestled down upon it, and then remained motionless. When flushed, it jumped back into the shrubbery, moved swiftly to the ground and disappeared along the stream. It made no sound. The female collected at this nest had in its oviduct a shelled egg, which was pale dull blue, and measured 26 by 35 mm. The gizzard of this bird contained a dragonfly and a roundworm.

Judging from the material in the Chicago Museum and National Museum collections, the supposed subspecies *guatemalensis* and *mexicanus* might possibly be separable, but because of the great individual variation we prefer to combine them as did Griscom (1932). Our birds match good series of *guatemalensis*, being considerably darker below than *ochraceiventris*.

Tityra semifasciata personata. Masked Tityra. 2 ♂♂, 2 ♂ im., March 31–August 5. We saw this species occasionally in a variety of habitats on the plateau and in the humid forests at La División and El Fénix, in groups of as many as four. In March and April we sometimes saw them chasing each other and once we saw one attack and drive off a *Pitangus sulphuratus*, but we found no nests. An *Accipiter chionogaster* taken at El Fénix carried a dead immature Tityra in its talons. The two adult males agree with a good series of *personata* from Chiapas, Campeche, and Guatemala. One of the immature males appears slightly closer to *griseiceps*.

Pyrocephalus rubinus. Vermilion Flycatcher. 3 ♂♂, 1 ♂ im., April 2–July 25. Noted only three times on the plateau in the spring and infrequently in July. The April specimen seems to have been a vagrant of the subspecies *flammeus*. It has the characteristic warm orange breast color of *flammeus* but the under tail coverts are pale pink like those of *blatteus*. The three July birds are clearly *blatteus*.

Muscivora forficata. Scissor-tailed Flycatcher. 1 ♂, March 30. During the spring individuals of this species often congregated in loose groups of a dozen or more in the open plateau country, perching near the tops of the *Acacia* trees and occasionally bickering with *Tyrannus melancholicus*. We saw none during July and August.

Tyrannus melancholicus chloronotus. Tropical Kingbird. 6 ♂♂, March 31–August 17. This was the most conspicuous flycatcher of the dry fields, frequenting the scattered mesquite growth on the plateau. The birds were noisy and petulant. On July 26 a flimsy nest situated precariously on a thin outer branch of an *Acacia* contained a single young bird.

Our specimens are much darker than *occidentalis* and are smaller and have blacker wings and tails than *couchii*. The spring male agrees with a large series of *chloronotus* from Chiapas in its darker tail, darker exposed portion of the primaries and smaller size. It differs from *occidentalis* in having much more intense yellow underparts, although the throat is as white as any of the specimens of the western race at hand.

Myiodynastes luteiventris luteiventris. Sulphur-bellied Flycatcher. 2 ♂♂, 1 ♂ im., 3 ♀♀, July 15–23. We found this species to be common in July along the watercourses on the plateau, where the birds moved about in family groups. We saw it occasionally in the deciduous forest at El Fénix in August. Our specimens agree with a large series of the nominate subspecies. This series has variants which are paler than a topotypical specimen of the doubtful subspecies *swarthi*.

Megarynchus pitangua mexicanus. Boat-billed Flycatcher. 2 ♂♂, 1 (sex?) im., 4 ♀♀, March 30–August 16. We found this species to be fairly common in July along the streams on the plateau. A March specimen with sooty black pileum and greenish-olive back agrees with a series of *mexicanus* from Chiapas and Yucatán. The summer birds fall among the pale extremes of a large series of *mexicanus*.

Myiozetetes similis texensis. Social Flycatcher. 3 ♂♂ im., 4 ♀♀, March 29–August 17. Whenever we approached the rivers on the plateau we encountered this querulous, nervous flycatcher. A new nest was found on April 2. We assign our specimens to *texensis*, although they are somewhat grayer than any comparable material at hand in the Chicago Museum.

Pitangus sulphuratus. Derby Flycatcher. 1 ♂, 3 ♀♀, 2 ♀ im., March 26–August 16. Along the rivers on the plateau this was the most conspicuous bird. It outnumbered *Myiozetetes similis*, with which it was closely associated, and it was more prominent because of its larger size and louder calls. In the spring it was considerably more numerous than *Megarynchus pitangua*, but we found the two species in about equal numbers in July and August. Edwards observed one carrying material to a partially completed nest on April 1.

All of our summer birds, including immature and breeding birds, have the dark olivaceous color of *guatemalensis* dorsally, but the March female shows some pale new feathers in the back plumage indicating it is close to *derbianus*. All tend toward *derbianus* in large size.

Myiarchus nuttingi. Nutting Flycatcher. 1 ♂, 2 ♀, 1 ♀ im., 1 (sex?) im., March 26–July 21. We saw it in small numbers almost daily in the spring and summer, generally in the sparse mesquite growth along the rivers. A family group frequently fed near our camp on the Río Monserrate in July.

Even after extensive comparisons and intensive study of this species, the taxonomic situation is not entirely clear to us. In working over our specimens we have been influenced strongly by Griscom's (1934:387ff) analysis of the species. The breeding birds of Monserrate appear to be closest to *inquietus*, the male tending toward *flavidior* in size. The female of March 26, presumably a transient, is intermediate between *inquietus* and *M. cinerascens*, but is somewhat closer to the latter.

Myiarchus tyrannulus. Mexican Crested Flycatcher. 1 ♂, 1 ♂ im., July 13, 14. We saw this species infrequently on the plateau in July. The adult is intermediate between *nelsoni* and *magister*.

Myiarchus tuberculifer lawrencei. Querulous Flycatcher. 5 ♂, 2 ♀, April 5–August 16. We saw this bird occasionally at El Fénix and La División, where it preferred the pine woods on the ridges. Individuals appeared occasionally on the plateau in mid-August. Three of our male specimens are *lawrencei*, while the male of August 16 and the female of April 5 are closer to *connectens* in size.

Nuttallornis borealis. Olive-sided Flycatcher. 1 ♀, August 16. Apparently this specimen is the first for Chiapas.

Contopus virens. Wood Pewee. 2 ♂, 3 ♀, 3 ♂ im., 1 (sex?) im., July 15–August 16. We did not record this species in the spring. In July and August it was common in open country and along the water courses on the plateau, where the birds moved about in family groups calling frequently. The resident subspecies, judging from the July specimens, is *sordidulus*. The August specimens appear to be *richardsonii* on the basis of size, and apparently are transients.

Contopus pertinax. Cores Flycatcher. 5 ♂, 2 ♀, August 2–10. Common in the pine and pine-oak woods at El Fénix in August. The birds frequently gave short scolding notes, but we never heard them call. We consider this population intermediate between *perlinax* and *minor*, most of our specimens being closer to *perlinax* in size.

Empidonax flaviventris. Yellow-bellied Flycatcher. 2 ♂, August 15. These two specimens, taken along the Río Grande, show a confusing combination of characters, but they appear to us to belong to this species.

Empidonax traillii traillii. Traill Flycatcher. 1 ♀, August 17.

Empidonax minimus. Least Flycatcher. 4 ♂, 3 ♀, March 25–August 16. This species seemed to be the most numerous of the transient empidonacines.

Empidonax flavescens dwighti. Yellowish Flycatcher. 3 ♂, August 3–9. We noted this species infrequently in the deciduous forest at El Fénix.

Tolmomyias sulphurescens cinereiceps. Sulphury Flat-bill. 1 ♂, 1 ♀, 1 ♂ im., 1 ♀ im., August 3–15. The irides of the adults were white, whereas those of the young were dark gray.

Rhynchocyclus brevirostris brevirostris. Eye-ringed Flat-bill. 3 ♂, 3 ♀, 1 ♀ im., April 5–August 11. We saw this flycatcher occasionally in the humid forest at El Fénix and La División. They moved about in small groups, occasionally voicing a very high-pitched *weess*.

Camptostoma imberbe. Beardless Flycatcher. 1 ♂, 1 ♂ (?), 2 ♀, 1 juv. (sex?), July 13–16. We saw and heard this species frequently in the dry mesquite areas on the plateau and at the laguna in July. We saw a single bird in the pine woods near El Fénix on August 7. The subspecies *ridgwayi* seems untenable.

Calocitta formosa pompata. Magpie-jay. 2 ♂, 3 ♀, April 1–July 23. This jay was common along the small streams and adjacent dry slopes on the plateau, often ranging a considerable distance away from water. In the spring many birds were paired. On March 26 Lea found a nest, probably of this species, on a tree branch overhanging the river, but no egg-laying was noted through April 6. In the summer we saw family groups and noted the great variety of call notes. Some calls were similar to those of *Crotophaga sulcirostris*. Our specimens belong to the Central American subspecies, which we believe should include the tenuous form *impudens*.

Xanthoeca yncas vivida. Green Jay. 3 ♂, 2 ♂ im., 2 ♀, 1 ♀ im., 1 (sex?) im., March 30–August 8. This species was common in the humid forests at La División and El Fénix in spring and summer. It was rare on the plateau where Edwards saw it on March 30 and July 23.

We have previously described the irides of *vivida* as bright yellow (Lea and Edwards, 1949:44). The adult birds from Chiapas had yellow irides, but the young male taken on August 5 had cloudy, pale yellowish brown irides and the immature bird collected on August 2 had brown irides with a very faint yellowish tinge.

Thryothorus pleurostictus acaciarum. Banded Wren. 7 ♂ ♂, 1 ♂ (?), 1 ♀, 1 ♀ nestling, March 25–August 16. In the spring we frequently saw well constructed retort-shaped nests made of what appeared to be seed stalks of small grasses, placed from four to six feet above the ground in *Acacia*.



Fig. 8. Nest of Banded Wren.

On March 31 Edwards saw a bird of this species at work on one of these nests. It made several trips to the nest, adding pieces of grass to the portion around the opening while the observer sat in plain view about 20 feet away. None of the nests that we examined contained eggs, but all appeared to be new.

This was the only species actively nesting in large numbers in July and August. We found many nests, some under construction, some with eggs and some with young. They were almost always on the edge of dense growth near a stream. The highest nest was about 20 feet above the ground, while most of them were less than 10 feet above ground, and a few were only about four feet up. In general there were two situations in which the nests were placed. Most often the nest was to be found in a small, thorny, ant-infested *Acacia*, close to the trunk. In these bulky, shaggy nests the entrance was a nearly horizontal tunnel. Less often we found the nest of *Thryothorus pleurostictus* built in pendant fashion near the end of a lower branch of a large tree. These nests were less bulky and more securely woven than the horizontal type, and they were more nearly retort shaped. They were similar to the nests of *Uropsila leucogastra* (Sutton, 1948), although not as compactly constructed and not having the entrance tunnel as tightly adherent to the nest body. The pendant nests were almost always close to and distal to a hornet's nest.

One of the horizontal nests which we watched closely from July 18 to 28 was a loosely made structure composed almost entirely of grasses (fig. 8). It was approximately twelve inches long and

eight inches high in its maximum external dimensions. The tunnel was neatly made and led slightly upward for about four inches to the top of the nest cavity. The nest was supported by three small branches, one at the base of the tunnel, one entwined in the body of the nest, and one through the superstructure. Crowded into the unlined cavity of the nest were six nestlings. Both of the adults were active in feeding small moths and insect larvae to the young. When entering, the adults flew into the tunnel without pausing at the entrance. Neither did they pause when emerging. When under observation, they scolded almost constantly when not gathering food. Three fledglings left the nest on July 26 and the other three left the following day.

We heard these birds singing daily in March, April, July, and August. The song was forceful and extremely varied. Some phrases were similar to those of a canary but lower in pitch and louder.

Troglodytes musculus intermedius. Tropical House Wren. 1 ♀, 4 ♂ im., 2 ♀ im., 2 (sex?), August 2-7. We saw this species frequently in the undergrowth in the pine-oak woods near El Fénix in August. It sang occasionally. Our specimens are slightly paler above and below than a small series of *intermedius* from Guatemala and Honduras in the Chicago Museum collection.

Henicorhina leucosticta prosthelauca. White-breasted Wood Wren. 1 ♂, 2 ♂ im., 1 ♀ im., 2 im. (sex?), August 2-9. Common, inquisitive and noisy in the deciduous forest at El Fénix in March and August.

Mimus gilvus gracilis. Tropical Mockingbird. 2 ♀ ♀, July 13-26. We saw this bird frequently along the roads and in the open mesquite ranges on the plateau. We noted its song occasionally in the spring and summer. The specimens are in much worn and discolored plumage, so their subspecific placement is provisional.

Turdus assimilis. White-throated Robin. 1 ♀ im., 1 im. (sex?), August 2-6. We saw small flocks of adults and young in the deciduous forest at El Fénix in August. Our material is not adequate for subspecific identification.

Turdus grayi grayi. Clay-colored Robin. 3 ♀ ♀, 4 ♀ im., 1 ♂ juv., March 30-August 11. In March and April we found this bird to be almost entirely confined to the heavy tree growth along the streams on the plateau. It was shy and quite inconspicuous in voice and action as well as color. The only sounds we heard it make were single *chucks* or a rapid series of *clucks* which seemed to be scold notes. In the summer we saw it in small numbers each day in the dense woods along the streams on the plateau and in the deciduous forest at El Fénix.

Myadestes obscurus oberholseri. Brown-backed Solitaire. 2 ♂ ♂, 2 ♀ ♀, 4 ♂ im., 1 ♀ im., April 5-August 8. Fairly common in the pine-oak woods and deciduous forests at La División and El Fénix in spring and summer. In August there were many immature birds in groups at El Fénix. We frequently noted their incomplete, atypical songs. Our two adult specimens are small and substantiate the belief of the describers (Dickey and van Rossem, 1925:133) that the range of *oberholseri* might extend into Chiapas.

Myadestes unicolor unicolor. Slate-colored Solitaire. 1 ♂, 1 ♂ im., August 5-11. We noted this species in dense forest at El Fénix on August 2, 5, 6 and 11. We rarely heard it sing. The remiges of our specimens have the slate gray edgings characteristic of the nominate race.

Catharus mexicanus mexicanus. Black-headed Nightingale-Thrush. 7 ♂ ♂, 2 ♀ ♀, 1 ♂ im., April 5-August 11. We saw this shy thrush frequently in the high deciduous forests in April and August. At La División on April 5 the birds uttered only a low *chuck* call-note very much like that of *Hylocichla guttata*. In August they were nesting, and singing persistently. Our specimens average slightly darker than Veracruz specimens of *mexicanus*, thus showing a tendency toward *cantator*.

Poliophtila caerules deppei. Blue-gray Gnatcatcher. 1 ♀, April 2. One was seen in the mesquite on April 1, also.

Poliophtila albiloris vanrossemi. White-lored Gnatcatcher. 6 ♂ ♂, 5 ♀ ♀, 2 ♂ im., 1 ♀ im., March 31-August 10. Almost daily we saw several of these birds in the mesquite or in sparse riverside cover. They were paired in the spring and in July. They sang occasionally in July, but we noted no songs in March or April. We watched the birds carefully in the field in late March, April, and July and observed that no males had white superciliary stripes. In contrast, all females that we scrutinized carefully had at least partial white superciliary lines and some white above and behind the posterior angle of the eye. Our female specimens show variations from white to grayish lores, the color often not being the same on both sides of an individual.

Cyclarhis gujanensis flaviventris. Rufous-browed Pepper Shrike. 5 ♂ ♂, 3 ♀ ♀, March 29-Aug-

ust 16. We saw this species occasionally at the laguna and along the streams on the plateau in spring and summer. Individuals sang frequently in both seasons, and at such times they were perched in the upper branches of trees 30 to 60 feet high. When they were not singing, we found them moving about in low, thick shrubbery or feeding acrobatically in fruiting trees. Any one individual kept to its own song pattern consistently, but there was great variation between the songs of different individuals. It was always a loud, clear song, the tone quality resembling that of the songs of the members of the genus *Sciturus*.

Vireo solitarius. Solitary Vireo. 1 ♀, March 26; 1 ♂, 1 (sex?), August 17. These two August specimens were collected in the pine-oak woods. Two others were heard on August 9 and 10. These specimens have the wing formula and large size of *montanus*, as do two from Escuintla, Chiapas, in the Chicago Museum collection. The breeding of the species in Chiapas and the occurrence of this subspecies in México apparently have not been recorded previously.

We saw individuals that presumably were transients of this species occasionally in the trees along the streams on the plateau and at the laguna in March and April. The March specimen is of the race *V. s. solitarius*.

Vireo gilvus gilvus. Warbling Vireo. 1 ♀, March 30. We saw one or two along the rivers on the plateau on March 30 and April 1 and 2.

Mniotilta varia. Black-and-white Warbler. 3 ♂ ♂, 2 ♀ ♀, March 28–August 10. This species was a rare transient in late March, when we saw only two individuals on the plateau. In August we saw it frequently in the pine-oak woods near El Fénix.

Dendroica auduboni. Audubon Warbler. 1 ♀, April 3. In the last week of March we saw only one, but on April 3 we recorded three more. All were in winter plumage. We did not see this species in July and August. The specimen is close to the borderline in size (wing 73 mm.) between *auduboni* and *memorabilis*.

Dendroica virens virens. Black-throated Green Warbler. 1 ♂, 1 ♀, March 29–April 2. This was the most common transient warbler in the area during late March and early April. We saw it frequently in the willows at the laguna. All individuals that we observed closely were in mixed plumage.

Dendroica chrysoparia. Golden-cheeked Warbler. 1 ♂, 1 ♂ im., August 9–11. Noted rarely in groups of two or three in the deciduous forest and pine-oak woods near El Fénix in August. The species has apparently not been recorded previously from Chiapas.

Dendroica graciae ornata. Grace Warbler. 2 ♂ ♂, 5 ♀ ♀, 1 ♀ im., 1 (sex?), July 15–August 7. We saw this species occasionally in the open pine woods on the plateau and frequently in the pine-oak woodland near El Fénix. Our specimens are heavier-billed and much purer gray (less brown) above than *graciae*, but they do not appear to be more heavily streaked. They are longer-winged and have less yellow on the underparts than *decora*.

Sciturus motacilla. Louisiana Water-thrush. 3 ♀ ♀, 2 ♂ ♂ im., July 21–August 8. At El Fénix in August we noted one or two individuals daily along the small mountain streams.

Oporornis tolmiei. Macgillivray Warbler. 1 ♂ (?), March 29. Noted occasionally in low brushy growth near water in March and April.

Chamaethlypis poliocephala palpebralis. Ground Chat. 6 ♂ ♂, 1 ♂ im., 1 ♀ im., 1 ♀ juv., March 29–August 3. We noted this species occasionally in the dry grassy fields on the plateau, and we located the territories of pairs in the spring. They were shy and secretive when approached closely. However, from a distance they could be located readily by their unusual call notes and song. In July we found them to be common in low willow thickets at the laguna and in the fields of tall grass.

The spring male has prominent yellow and white markings on the upper and lower eyelids and is quite long-tailed. In the summer series the whitish markings above and below the eye are not always clearly evident, but all have at least a trace of white. On the basis of the white markings and the very long tails of all the specimens we place them with the northern subspecies.

Icteria virens virens. Yellow-breasted Chat. 1 ♀, March 29. Noted only in the spring when we saw a few individuals from March 29 to April 2 near streams on the plateau.

Wilsonia pusilla pileolata. Pileolated Warbler. 1 ♀, April 6. Taken in the humid forest at La División.

Setophaga picta guatemalae. Painted Redstart. 2 ♂ ♂, 1 ♂ im., 2 ♀ ♀, 1 (sex?), August 2–7. We saw a single bird among the open pines of the lower mountain slopes on March 27 and found the

species to be common in the pine-oak woods near El Fénix in August. Our specimens are considerably closer to *guatemalae* than to *picta*, having little or no white on the third rectrix and little white on the edgings of the tertials.

Myioborus miniatus intermedius. Slate-throated Redstart. 2 ♂♂, 2 ♀♀, 1 ♂ im., 2 ♀♀ im., March 27–August 11. We found this species to be the most abundant warbler, excepting *Basileuterus culicivorus*, in the humid forests at La División and El Fénix in the spring and summer. In April we frequently heard two or three males singing at one time. Most of our specimens fit readily with *intermedius*. Two with slightly more orange bellies tend toward *hellmayri*.

Euthlypis lachrymosa. Fan-tailed Warbler. 2 ♀♀, August 11. Noted only on August 11 in humid forest at El Fénix. After comparing a large number of specimens in the Michigan Museum and Chicago Museum, we agree with those who synonymize all the supposed subspecies.

Basileuterus culicivorus culicivorus. Golden-crowned Warbler. 3 ♂♂, 1 ♀, 1 (sex?), 1 ♀ juv., 4 im. (sex?), March 27–August 6. This was the most common warbler in the humid forests at La División and El Fénix, but we did not hear its song as frequently as we did that of *Myioborus miniatus*.

Basileuterus rufifrons rufifrons. Rufous-capped Warbler. 4 ♂♂, 2 ♂♂ im., 1 ♀ im., 3 (sex?) im., April 5–August 7. Edwards collected a breeding male in the scorched weeds just south of La División on April 5. In August we noted the species frequently both in the humid forest and the pine-oak woods at El Fénix.

Cassiculus melanicterus. Mexican Cacique. 5 ♂♂, 1 ♂ im., 2 ♀♀, March 26–August 16. This spectacular bird was fairly common along the streams on the plateau. In March and April individuals flew about in loose groups. They made a variety of strange noises, some of them quite similar to the twig snapping and swishing sounds of *Cassidix mexicanus*. In July and August we often saw noisy mixed flocks of immature and adult birds in the dense growth along the rivers, and we found some occupied nests.

The nests were tightly woven, pendant structures, approximately 18 to 30 inches long. They were on the ends of branches overhanging the rivers, about 25 to 50 feet above the water. The high nests were sometimes conspicuously located, but we never found them in cleared, open areas like the nests of some of the orioles in the region. The lower nests were usually concealed in dense growth. We sometimes found as many as three or four nests in one group of trees, but the species was not nearly so markedly colonial as is *Gymnostinops montezuma*.

One nest that we studied was built in a *Ficus* about 25 feet above the "two-mile river." The entrance at the top of the pendant structure was partly concealed by leaves on the twigs that supported the nest. It contained young birds. During a period of about eight hours on July 22 and 23, only the female came to the nest. This bird was silent as it flew to the nest and darted in with only a momentary pause at the entrance. It remained inside the nest for periods lasting from 30 seconds to several minutes. The nestlings often chattered while the adult was in the nest. The adult left the nest silently, never pausing at the entrance to survey the nest area. The intervals between feedings usually were 20 to 30 minutes.

Virginia Lea found a very young bird on the ground, unable to fly. When she attempted to catch it, the nestling squawked loudly and stirred up a commotion among a group of adult caciques in the trees overhead. Five adult birds in succession attacked her when she was near the nestling, swooping down at her with loud cries and noisy flapping of wings. When she picked up the nestling the adults intensified their protests, two of them actually striking her on the head with their bills.

This species was well known to the people at the hacienda, as much for its peculiar and offensive odor as for its brilliant yellow and black plumage. We could sense the strong musky odor of the bird when holding it in the hand, and even after several months as a prepared specimen the skin retained the scent.

Tangavius aeneus. Red-eyed Cowbird. 1 ♀, 1 ♀ im., July 21. We saw this species in small numbers almost daily on the plateau in spring and summer, particularly around the corrals and ranch buildings at Monserrate. The breeding female appears to be in mixed immature and adult plumage and we are unable to place it subspecifically.

Cassidix mexicanus mexicanus. Boat-tailed Grackle. 1 ♂, 1 ♂ im., April 2–July 25. Around the houses and farmyards this was an abundant and conspicuous bird. We saw birds carrying nesting material in early April; they were nesting and roosting in thickly leaved trees around the ranch house. A breeding male specimen (wing 205 mm.) is large even for *mexicanus*.

Icterus spurius. Orchard Oriole. 1 ♂, April 2. We saw several of both sexes in late March and early April, always near the streams on the plateau.

Icterus wagleri wagleri. Wagler Oriole. 1 ♀ im., April 1. Lea collected the specimen along the Río Monserrate. We saw an adult on the plateau in early August.

Icterus chrysater chrysater. Lesson Oriole. 4 ♂ ♂, 2 ♂ ♂ im., 1 (sex?), August 2–11. Common at El Fénix where we saw small flocks in the pine, pine-oak, and deciduous forests. Two of the adult males have black covering most of the crown, as in specimens which were once designated as *I. gularensis*.

Icterus gularis gularis. Black-throated Oriole. 2 ♂ ♂, 1 ♀, July 18–August 15. In July and August we saw this oriole occasionally in small family groups along the watercourses on the plateau. In size the specimens tend somewhat toward the smaller *trogodytes*.

Icterus pustulatus formosus. Streak-backed Oriole. 2 ♂ ♂, 6 ♀ ♀, March 25–August 16. The common oriole on the plateau. We found this species in small flocks near the watercourses in the spring. The birds were not singing, but we did note them scolding, calling, and chasing one another. At that time they had not begun nest construction. In July and August there were many family groups with young birds. There were a few active nests of this species along the rivers, and also many nests no longer in use at this time. The nests were usually placed in conspicuous locations in the smaller trees about 15 to 25 feet above the ground. They were short-necked, rather flimsy, pendant structures, approximately 12 inches long.

Sturnella magna alticola. Eastern Meadowlark. 1 ♂, 3 ♀ ♀, 1 juv. (sex?), April 3–July 17. We saw about six during our two weeks in Chiapas in March and April. In July the species was abundant in the same areas and was obviously breeding. We assign our specimens to *alticola* as defined by Griscom (1934:390).

Tanagra affinis affinis. Lesson Euphonia. 1 ♂, 2 ♀ ♀, July 18. We saw a group on July 18 and July 26 in the mesquite fields.

Piranga rubra rubra. Summer Tanager. 1 ♂, March 30. We saw only a few, along the rivers on the plateau in March. The specimen is in mixed red and yellowish plumage. It is typical of *rubra* in its small size.

Piranga flava dextra. Hepatic Tanager. 9 ♂ ♂, 6 ♀ ♀, 1 ♂ im., 1 (sex?), March 27–August 9. In the spring we recorded this species frequently in the heavy growth along the streams, in the sparsely wooded pine ridges on the plateau and in the dense forest at La División and El Fénix. One male taken on April 2 was colored much like a female but was somewhat more orange on the throat and top of the head. It had been singing persistently and its testes were slightly enlarged. Some of these tanagers flew about in pairs in March.

Our spring specimens match a small series of supposed *dextra* in the Michigan Museum in coloration. But in view of the worn condition of most of our specimens and the difficulty of separating the subspecies even in fresh material, assignment of the Monserrate population to *dextra* is only provisional.

Piranga leucoptera leucoptera. White-winged Tanager. 1 ♀, March 27. An adult male and female together in the humid forest constituted our only record.

Chlorospingus ophthalmicus ophthalmicus. Brown-capped Chlorospingus. 2 ♂ ♂, 1 ♂ im., 3 ♀ ♀, 6 ♀ ♀ im., 1 im. (sex?), April 5–August 9. We found this species to be common in the humid forests at La División and El Fénix. The birds often chased each other in the thick undergrowth while making a chatter of rapidly repeated sibilant notes. Their songs and call notes were quite high-pitched also. We frequently saw flocks moving about in the tops of the trees at El Fénix.

Our adult specimens are readily separable from a large series of *postocularis* in being distinctly browner (not slaty) on the forehead, crown, nape and auriculars. The subspecies *ophthalmicus* has not been previously recorded from Chiapas.

Saltator atriceps peeti. Black-headed Saltator. 1 ♂, 3 ♀ ♀, 1 ♀ im., March 31–August 15. In heavy growth near the streams on the plateau we found *Saltator atriceps* in small numbers in spring and summer. Its loud staccato calls betrayed its presence.

Our adult female specimens are closest to *peeti*, being even larger than any of the series which Brodorb (1940:548) examined in describing the subspecies. The wing of the male specimen, which may not be fully adult, is below the size range of *peeti*, but the bird is quite long-tailed. We consider our birds to be extreme examples of *peeti*, extending the range of that subspecies to the Atlantic side

of the Continental Divide, about 40 miles northwest of the previously defined westerly limit of its range at Tonalá.

Pheucticus ludovicianus. Rose-breasted Grosbeak. 1 ♀, March 31. We saw this species only on the last two days of March; first a flock of four and again a single bird were noted.

Guiraca caerulea eurhyncha. Blue Grosbeak. 1 ♂ im., 1 ♀, July 16-24. In the spring this species occurred in small flocks on the plateau with *Passerina cyanea*. In July we saw one or two of these shy birds almost daily in the same areas and occasionally we heard them sing.

Passerina cyanea. Indigo Bunting. 1 ♂, March 26. In the mesquite-grown fields we often encountered flocks of this species near, or mixed with, small flocks of *Guiraca caerulea*, from March 26 to April 1.

Passerina ciris pallidior. Painted Bunting. 1 ♂, April 6. Lea collected this male in breeding plumage from a group in low brush at La División. We place it with *pallidior* primarily on the basis of its large size.

Volatinia jacarina splendens. Blue-black Grassquit. 4 ♂ ♂, 1 ♀, July 22-26. We occasionally saw females, singing males, and fledglings in moist fields on the plateau in July. Virginia Lea watched a male bird engaging in an excited courtship performance atop a corn stalk. Without actually leaving the perch the tiny bird bounced vigorously up and down with flapping wings, uttering a strained, shrill buzzy note at each upward bounce.

Spinus notatus notatus. Black-headed Siskin. 4 ♂ ♂, 3 ♂ ♂ im., 1 ♀, July 15-August 5. We noted flocks occasionally in the open pine woods on the plateau in July and very often in the pine-oak woods near El Fénix in August; both immatures and singing adult males were in the same groups. Our specimens show the rich golden tone of the nominate subspecies.

Loxia curvirostra mesamericana. Red Crossbill. 3 ♂ ♂, 1 ♂ im., 2 ♀ ♀, 1 ♀ im., August 3-9. We often saw flocks feeding in the pine woods near El Fénix in August, and on one occasion, August 3, heard a male sing. Subspecific placement is on the basis of the small size of our specimens. Two red males, perhaps not in fully adult plumage, do not show the supposed dark coloration of *mesamericana*. The situation seems to be similar to what Griscom (1937) found when he described the few known Guatemala males as *mesamericana* in size and more like *stricklandi* in color.

Atlapetes brunnei-nucha brunnei-nucha. Chestnut-capped Atlapetes. 2 ♀ ♀, 1 ♂ im., 2 ♀ ♀ im., August 7-11. We noted this species in the dense forest on the highest slopes at El Fénix.

Ammodramus savannarum perpallidus. Grasshopper Sparrow. 1 ♀, April 3. This specimen is intermediate between *pratensis* and *perpallidus*; it is similar to the former in darker, less buffy coloration above and slightly smaller size, but it is placed with the latter because of its slender bill.

Aimophila ruficauda lawrencii. Russet-tailed Sparrow. 1 ♂, 4 ♀ ♀, 1 (sex?), March 25-July 17. We saw this sparrow almost daily on the plateau in March, April, and July. Its common call note was extremely high pitched. Our specimens, with gray backs and gray-brown tails, are well-marked examples of *lawrencii*.

Aimophila rufescens rufescens. Rusty Sparrow. 2 ♂ ♂, 3 ♀ ♀, 1 ♂ im., 3 ♀ ♀ im., 1 im. (sex?), April 6-August 7. We saw this sparrow occasionally at La División in April and very often near El Fénix in August. It was the common sparrow in the thick brush in the pine-oak woods. Our worn specimens are close to comparable *rufescens*. One female shows a slight tendency toward *gigas* in length of tail (73 mm.). Our April specimen is much buffier below and much darker and more heavily streaked above than topotypes of *cinerea* from near this locality.

Aimophila botterii. Botteri Sparrow. 2 ♂ ♂, 1 ♂ im., July 15-19. In the grassy upland fields on the plateau we saw this bird occasionally in July. We heard it sing occasionally.

Our specimens are intermediate between *A. b. botterii* and *A. (botterii) petenica*, although closer to the former, which they match in size. They are much grayer above than comparable material from Arizona, Texas, Sonora, and Tamaulipas and the chestnut edgings of the central black shaft streaks on the back are darker. They do not have the dusky lores of *petenica*, nor do the back feathers show such broad black shaft streaks with such dark edgings. However, they do help to bridge the gap between *botterii* and *petenica*. Two August specimens in the Chicago Museum from Ocosingo, Chiapas, are even closer to *petenica* in back coloration, even though they are in quite worn plumage.

Spizella passerina mexicana. Chipping Sparrow. 1 ♂, 4 ♀ ♀, 1 ♀ im., July 25-August 10. We saw small flocks in July and August in the open pine woods on the plateau and in the pine-oak woods near El Fénix.

Melospiza lincolni lincolni. Lincoln Sparrow. 1 ♀, March 29. We saw four on the plateau during the last three days of March.

LITERATURE CITED

- Bangs, O., and Peters, J. L.
1928. A collection of birds from Oaxaca. Bull. Mus. Comp. Zool., 68:385-404.
- Beecher, W.
1950. Convergent evolution in the American orioles. Wilson Bull., 62:51-86.
- Berlioz, J.
1939. Etude d'une collection d'oiseaux du Chiapas (Mexique). Bull. Mus. Hist. Nat. Paris, ser. 2, 11:360-377.
- Brodkorb, P.
1940. New birds from southern Mexico. Auk, 57:542-549.
- Dickey, D. R., and van Rossem, A. J.
1925. Four new birds from Salvador. Proc. Biol. Soc. Wash., 38:133-136.
- Griscom, L.
1932. Distribution of bird life in Guatemala. Bull. Amer. Mus. Nat. Hist., 64:439 pp.
1934. The ornithology of Guerrero, Mexico. Bull. Mus. Comp. Zool., 75:367-422.
1937. A monographic study of the red crossbill. Proc. Bost. Soc. Nat. Hist., 41:77-210.
- Hellmayr, C. E., and Conover, B.
1949. Catalogue of birds of the Americas. Field Mus. Nat. Hist., Zool. Ser., 13, pt. 1, no. 4:1-358.
- Lea, R. B., and Edwards, E. P.
1949. Eye-color of the green jay in Mexico. Condor, 51:44.
- Moore, R. T.
1934. A review of the races of *Geococcyx velox*. Trans. San Diego Soc. Nat. Hist., 7:455-470.
1940. Notes on Middle American empidonaces. Auk, 57:349-389.
- van Rossem, A. J.
1938. Descriptions of two new races of the ground cuckoo (*Morococcyx erythropygus* [Lesson]) from Mexico. Proc. Biol. Soc. Wash., 51:169-171.
- Amherst, Virginia, and New Orleans, Louisiana, May 4, 1954.*

COMPARATIVE OSTEOLOGY OF THE NIGHT HERONS

By CLAUDE T. ADAMS

This paper is an attempt to evaluate taxonomically the osteological characters of the Black-crowned Night Heron, *Nycticorax nycticorax*, and the Yellow-crowned Night Heron, *Nyctanassa violacea*.

I acknowledge gratefully the loan of material from the Museum of Vertebrate Zoology of the University of California, and from the University of Kansas Museum of Natural History. I am especially indebted to Dr. Pierce Brodkorb, whose timely comments and criticisms were helpful in the preparation of this paper.

MATERIALS AND METHODS

Sixty skeletons of the two genera were compared, 41 *Nycticorax* and 19 *Nyctanassa*. Specimens of the Black-crowned Night Heron were from populations currently assigned to the subspecies *N. n. hoactli* (Florida, Kansas, Nevada, Colorado, and California). Specimens of the Yellow-crowned Night Heron were from populations currently assigned to the subspecies *N. v. violacea* (Florida and Kansas). Forty-seven measurements were taken from each of the specimens under consideration. The measurements were similar to those taken by Baumel (Condor, 51, 1953:26-32) and Glatfelter (1950, unpublished thesis, Univ. Fla.). Terminology follows Howard (Univ. Calif. Publ. Zool., 32, 1929:301-394). A total of 18 ratios between the various elements was computed in an effort to magnify the differences between the two species studied. Two statistical methods were used to indicate differences between the two species studied. These were (1) the significance of differences according to *t* values, and (2) the coefficient of divergence.

DISCUSSION

Measurements of *Nycticorax nycticorax* and *Nyctanassa violacea* are given in tables 1 and 2. These tables include only those measurements whose differences show a *t* value greater than 3.0 and hence those measurements considered to be of value for the separation of the two genera.

Sexual variation.—Using data from tables 1 and 2, the statistical coefficient of divergence (Klauber, Trans. San Diego Soc. Nat. Hist., 9, 1940:195-214) was used to determine the amount of sexual dimorphism present.

In *Nycticorax nycticorax*, the mean measurements of the male exceed those of the female in all except the maxillary width and the synsacrum width. In these measurements, the mean of the female exceeds the mean of the male by less than 2.0 per cent. There is overlap in the ranges of all measurements taken.

In *Nyctanassa violacea*, the mean measurements of the male exceed the mean measurements of the female in 41 of the measurements taken. In six measurements the mean of the female exceeds the mean of the male. Each of the coefficients of divergence for these six measurements is less than 3.5 per cent. Overlap occurs in all measurements except the preorbital width, and this measurement shows a separation of only 0.1 mm.

Species differences.—The following arbitrary criteria were set up for optimum separation of the two species: (1) measurements separated by three standard deviations of each form; (2) measurements separated by two standard deviations of each form; (3) measurements separated by one standard deviation; (4) measurements separated by one standard deviation only when the same sexes are compared.

In one measurement, the naris length, the mean of *Nycticorax* exceeds the mean of *Nyctanassa* by more than three standard deviations.

In five measurements the means of *Nycticorax* exceed the means of *Nyctanassa* by

two standard deviations. These are the skull length, basal skull length, zygoma length, pterygoid length, and femur length. By the same statistic, the mean length of the tarsus of *Nyctanassa* exceeds the mean length of the tarsus of *Nycticorax* by two standard deviations.

Table 1
Measurements of *Nycticorax nycticorax* in Millimeters

Measurements	Males (24)			Females (17)		
	Mean	Range	SD	Mean	Range	SD
Skull length	136.42	128.0-143.5	3.44	130.53	122.3-139.0	1.45
Basal skull length	135.42	126.5-143.0	3.80	128.88	121.3-134.8	1.41
Cranial length	57.42	54.9-59.5	1.44	55.88	53.3-57.8	1.41
Postorbital width	37.74	34.6-40.0	1.07	36.43	35.3-37.8	.70
Preorbital width	17.83	16.4-18.7	.64	17.89	16.1-19.0	.67
Zygoma length	57.54	55.0-61.2	1.70	56.14	52.4-57.2	.65
Pterygoid length	14.42	12.9-15.2	.54	13.65	12.9-14.3	.38
Ramus length	128.83	120.0-136.2	3.65	123.14	113.9-132.0	5.25
Naris length	18.81	17.4-20.8	.96	17.49	16.1-18.5	.40
Quadrate width	18.03	16.6-19.1	.53	17.25	16.4-18.2	.64
Quadrate length	22.32	20.6-23.2	.64	21.16	19.6-22.0	.57
Pre-iliac width	14.53	13.3-15.7	.77	13.81	12.5-15.2	.70
Pelvic width	20.60	19.2-22.6	1.02	19.83	18.5-21.2	.91
Innominate depth	15.35	14.5-16.6	.58	14.65	13.4-16.0	.70
Acetabular width	6.18	5.6-6.9	.31	5.89	5.3-5.6	.32
Femur length	77.11	73.6-80.4	2.13	73.85	71.2-78.0	1.84
Proximal femur width	13.17	12.3-14.1	.59	12.68	11.8-13.2	.35
Distal femur width	12.43	11.4-13.4	.55	12.13	11.5-12.5	.32
Tibia length	128.50	119.6-136.4	4.03	124.70	115.8-133.0	4.36
Proximal tibia width	10.82	10.2-11.6	.45	10.29	9.6-11.0	.37
Distal tibia width	10.81	9.9-11.3	.48	10.31	9.6-10.9	.31
Tarsus length	83.75	77.0-89.7	3.46	81.07	77.6-87.2	2.62
Coracoid length	55.02	52.0-57.2	1.47	52.43	49.8-55.3	1.45
Scapula length	68.81	63.9-71.8	2.14	64.95	61.5-69.1	2.15
Humerus length	119.67	114.0-128.8	3.28	112.60	106.0-116.2	3.95
Carpometacarpus length	65.36	61.6-70.1	2.17	62.85	59.2-65.3	1.10

In eight measurements the means of *Nycticorax* exceed the means of *Nyctanassa* by one standard deviation. These are cranial length, postorbital width, ramus length, quadrate width, quadrate length, proximal femur width, innominate depth, and carpo-metacarpus length. In two measurements the means of *Nyctanassa* exceed those of *Nycticorax* by one standard deviation. These are the pre-iliac width and the pelvic width.

Ten measurements show a separation of one standard deviation when the same sex is compared but show overlap between the largest female of one species and the smallest male of the other. These measurements are preorbital width, foramen magnum depth, tibia length, proximal tibia width, distal tibia width, midsternum width, clavicle length, acetabular width, scapula length, and humerus length.

The remaining 20 measurements showed separation of less than one standard deviation, even when compared sex for sex.

Further support of the separation of the two genera is indicated by the significance of differences test by *t* values. On the basis of the *t* values, the measurements were divided into three classes: (1) *t* = 3.0 or more; (2) *t* = 2.0 - 2.9; (3) *t* = less than 2.0.

The differences between the means of the following 26 measurements are of unquestionable statistical significance (*t* = 3.0 or more, *p* = .003 or less): skull length, basal skull length, cranial length, postorbital width, preorbital width, zygoma length, pterygoid length, ramus length, naris length, quadrate length, quadrate width, pre-iliac

Table 2
Measurements of *Nyctanassa violacea* in Millimeters

Measurements	Males (8)			Females (11)		
	Mean	Range	SD	Mean	Range	SD
Skull length	122.25	118.5-124.8	2.11	118.32	111.4-122.5	3.24
Basal skull length	120.50	116.0-123.0	2.60	116.95	110.0-121.8	3.20
Cranial length	53.25	52.1-54.9	.97	52.09	49.9-53.7	1.16
Postorbital width	34.50	33.4-35.9	1.00	33.84	32.4-35.2	.95
Preorbital width	20.50	16.1-23.3	1.80	15.24	14.7-16.0	.48
Zygoma length	49.74	48.4-50.8	.83	49.27	45.8-50.8	1.30
Pterygoid length	11.80	11.5-12.3	.23	11.73	10.6-12.3	.51
Ramus length	112.25	109.6-114.5	1.71	109.64	102.0-112.5	3.47
Naris length	13.39	12.6-14.1	.53	12.70	11.6-13.6	.62
Quadrate width	18.68	15.0-16.9	.52	15.83	14.8-16.6	.51
Quadrate length	19.30	18.4-20.1	.51	18.63	17.9-20.1	.57
Pre-ilium width	16.63	15.7-17.6	.54	16.16	14.7-17.0	.76
Pelvic width	20.60	19.2-22.6	1.02	23.77	20.8-24.4	1.21
Innominate depth	13.38	12.6-14.3	.48	13.35	12.3-14.0	.17
Acetabular width	5.30	4.5-6.2	.59	5.48	5.0-6.0	.26
Femur length	66.00	63.3-69.8	1.68	64.70	62.3-68.3	2.19
Proximal femur width	11.63	10.9-12.4	.50	11.55	10.7-12.0	.44
Distal femur width	11.44	10.5-11.9	.40	11.59	10.6-12.0	.11
Tibia length	140.13	133.6-148.0	4.64	134.27	126.8-143.5	4.45
Proximal tibia width	9.71	9.0-10.3	.51	9.37	8.9-9.8	.29
Distal tibia width	9.90	9.5-10.5	.40	9.53	8.9-10.2	.39
Tarsus length	103.25	95.8-107.4	3.60	98.77	92.9-104.3	3.72
Coracoid length	51.50	48.3-54.7	2.37	49.00	46.8-51.2	1.21
Scapula length	61.38	59.4-62.9	.93	61.95	58.1-66.4	2.27
Humerus length	110.00	106.0-114.7	3.06	107.18	103.5-111.0	2.48
Carpometacarpus length	61.82	59.0-63.5	1.32	59.77	57.2-62.9	1.76

width, pelvic width, innominate depth, acetabular width, femur length, proximal femur width, distal femur width, tibia length, proximal tibia width, distal tibia width, tarsus length, coracoid length, scapula length, and carpometacarpus length. The t values for these measurements range from 25.2 for the naris length of the females to 3.3 for the proximal humerus width of the males.

The following four measurements show a t value greater than 3.0 for the males, but less than 3.0 for the females. These are external lamina length, sternum width, clavicle length and proximal humerus width. Four measurements show a t value greater than 3.0 for the females, but less than 3.0 for the males. These are maxillary width, postacetabular width, distal humerus width, and humerus shaft diameter.

The differences between the means of the synsacrum length has a t value of 2.5 and is therefore considered statistically significant.

Measurements showing t values of 2.0-2.9 for the males only are as follows: coracoid width, humerus shaft diameter, ulna length, and radius length. Measurements showing similar values for females only are ischium length, ilio-ischiatic fenestra, femur shaft diameter, sternum width, and proximal humerus width.

Other measurements are not considered statistically significant and for this reason are not listed here.

To indicate further the differences between *Nycticorax* and *Nyctanassa*, the coefficient of divergence was calculated for each measurement. *Nycticorax* exceeds *Nyctanassa* in 33 and 35 measurements, for the males and females, respectively, while *Nyctanassa* exceeds *Nycticorax* in 14 and 12 measurements for the males and females, respectively.

Ratios.—The purpose of ratios in comparisons of skeletal elements is to magnify the differences in proportions existing between *Nycticorax* and *Nyctanassa*. The ratios were computed on the basis of the measurements of individual specimens in order to eliminate any inherent error that might occur. These ratios, expressed in per cent, are given in table 3.

Table 3
Mean, Minimum, and Maximum Ratios in Per Cent

Ratio	<i>Nycticorax nycticorax</i>				<i>Nyctanassa violacea</i>			
	Male Range	Male Mean	Female Range	Female Mean	Male Range	Male Mean	Female Range	Female Mean
Lamina: zygoma	61.6–70.5	65.04	61.1–68.4	64.15	68.1–75.8	71.31	69.2–78.7	73.91
Ramus: skull	91.3–96.2	94.44	92.8–96.2	94.14	90.7–92.6	91.68	91.3–94.0	92.32
Postorbital: cranium	59.9–68.2	65.92	62.3–68.5	65.68	63.7–67.1	65.25	61.1–69.1	65.02
Pterygoid: quad- rate length	59.8–68.1	64.42	60.2–68.8	64.35	59.2–64.7	61.64	55.8–65.4	62.28
Pterygoid: quad- rate width	73.3–83.9	80.01	72.2–84.8	78.72	72.3–78.7	74.70	67.1–79.1	73.72
Foramen magnum width: depth	82.4–103.4	90.45	76.9–96.6	87.38	83.6–96.9	91.47	82.3–95.2	89.06
Interorbital: skull	11.7–15.9	14.34	12.5–16.4	14.34	14.1–17.3	15.10	12.5–16.9	15.17
Preorbital: skull	11.9–13.9	13.06	12.3–13.8	13.15	13.5–18.8	16.86	12.3–13.5	12.91
Postorbital: skull	25.2–29.1	27.65	26.6–29.6	28.01	27.5–29.2	28.37	27.8–31.0	28.67
Tarsus: ulna	61.9–67.9	64.35	61.4–68.6	64.88	75.6–82.3	80.22	76.9–81.0	79.11
Femur: tibia	58.1–62.3	59.83	57.7–61.5	59.24	44.1–49.2	47.31	47.6–49.7	48.52
Tarsus: tibia	62.6–66.7	64.96	62.3–67.8	65.04	69.7–76.8	73.81	71.5–76.2	73.42
Femur: humerus	58.8–66.5	64.16	64.4–67.4	65.70	59.6–60.9	60.07	58.9–62.1	60.67
Tibia: ulna	95.5–101.7	98.69	98.5–102.9	100.75	105.5–115.2	109.33	103.7–110.6	107.34
Carpometacarpus: tarsus	75.6–82.1	78.06	74.1–80.2	77.26	56.5–61.6	59.69	58.7–62.7	60.48
Sternum width: length	41.1–51.0	47.83	42.4–51.5	46.98	40.1–45.2	43.52	39.3–49.4	43.64
Innominate: syn- sacrum width	47.7–53.9	50.21	41.4–52.8	48.77	37.3–43.4	40.65	37.9–44.6	41.93
Synsacrum width: length	49.3–57.3	53.48	51.7–61.0	55.24	54.9–69.0	60.77	54.4–67.3	59.89

The mean ratios of the various measurements are of the same magnitude in both sexes of a given genus, indicating no sexual dimorphism. The variation is less than three per cent with overlap in all cases.

The ratios of the skull elements of *Nyctanassa* are of the same magnitude as those of *Nycticorax*. The overlap in the ranges is such that no significant difference is indicated in the skull ratios under consideration.

Much the same condition exists in the body ratios of the two genera. Of the 14 ratios computed on the skeletal elements of the body, only five are considered worthy of mention:

(1) Carpometacarpus: tarsus. The difference between the ranges of this ratio indicates excellent separation, the lower limit of the range of *Nycticorax* being 12 per cent larger than the upper limit of the range of *Nyctanassa*. This difference is attributed to the greater length of the carpometacarpus of *Nycticorax* and the greater length of the tarsus of *Nyctanassa*.

(2) Femur: tibia. The lower limit of the range of *Nycticorax* is eight per cent greater than the upper limit of the range of *Nyctanassa* for this ratio. This is attributed to the greater length of the femur of *Nycticorax*, and the greater length of the tibia of *Nyctanassa*.

(3) Tarsus: ulna. This ratio is greater in *Nyctanassa* than in *Nycticorax*, the lower limit of the range of *Nyctanassa* being seven per cent greater than the upper limit of the range of *Nycticorax*. This, again, is attributed to the greater length of the tarsus of *Nyctanassa* and the greater length of the ulna of *Nycticorax*.

(4) Tarsus: tibia. The lower limit of the range of this ratio for *Nyctanassa* is two per cent greater than the upper limit of the range for *Nycticorax*. The tarsus and the tibia are both significantly larger in *Nyctanassa* than in *Nycticorax*.

(5) Tibia: ulna. This ratio is shown to be greater in *Nyctanassa* than in *Nycticorax*, the lower limit of the range of the former exceeding the upper limit of the latter by one per cent. This difference is attributed to the greater length of the tibia in *Nyctanassa* and the greater length of the ulna in *Nycticorax*.

Other perceptible differences.—Characters such as contour and conformation of the elements under consideration were impractical to measure but deserve comment. These characters were examined by comparison with specimens of other species of American herons. Variations are noted below:

(1) Nasal septum. According to Shufeldt (Ann. Carnegie Mus., 1, 1901:158-249), the osseous nasal septum is either incomplete or entirely missing in the subfamily Ardeinae. The septum exists in *Nyctanassa* only as a very small, partially ossified sliver along the median dorsal line of the nares, so reduced as to be almost missing.

In *Nycticorax* the nasal septum, partially ossified, extends anteriorly along the dorso-median line of the nares for two-thirds of their length. The septum runs diagonally from the anterodorsal angle of the external nares to the posteroventral angle.

An examination of the other American members of the subfamily Ardeinae shows them to be divided into two well defined groups with respect to the nasal septum. *Florida caerulea* is the only form found to possess the enlarged nasal septum as in *Nycticorax nycticorax*. The remainder of the American species are found to have only a very small, partially ossified nasal septum and would therefore be placed in the same general group as *Nyctanassa violacea*.

(2) Nasal grooves. In *Nycticorax nycticorax* a slit runs forward fully two-thirds the length of the culmen, from the anterior angle of the external nares. This appears to be an extension of the nasal opening, and it may be the remnant of once greatly enlarged external nares. This groove does not occur in *Nyctanassa violacea*.

In the day herons at my disposal the external nares end rather abruptly, with only a slight indentation appearing on the culmen. The genus *Hydranassa* most nearly approaches the condition found in *Nycticorax*.

(3) Ectethmoid. In *Nycticorax* the ectethmoid consists of two parts. The larger part extends out almost at right angles to the interorbital septum, to make a flat, plate-like projection anterior to the eye. The second part joins the first by means of a narrow bridge in the upper anterior region of the interorbital septum. This then extends forward and lateral to the lacrymal, just below the frontal bone. This condition of the

ectethmoid bone in *Nycticorax* may be correlated with the nocturnal habits of the form, serving as an extra support for the greatly enlarged orbit.

In *Nyctanassa* the frontal portion of the ectethmoid is reduced in comparison with that of *Nycticorax*. The anterior and posterior portions of the ectethmoid bone are separate, there being no osseous connection between the two parts.

The day herons may be separated into three groups on the basis of the conformation of the ectethmoid bone. In the genera *Ardea* and *Casmerodius* the ectethmoid is similar to that of *Nycticorax*, while the genera *Leucophoyx* and *Florida* resemble *Nyctanassa*. Two genera, *Butorides* and *Dichromanassa*, are intermediate, having the enlarged frontal portion as in *Nycticorax*, but with the median connecting portion missing as in *Nyctanassa*.

(4) Supraorbital foramen. In each orbit of *Nycticorax*, above and anterior to the optic foramen, there is an additional opening into the braincase, which Shufeldt termed the optic vacuity. This is here referred to as the supraorbital foramen.

In *Nyctanassa* the supraorbital foramen is absent. The single foramen occurring at the median posteroventral angle of the interorbital septum appears much the same as in *Nycticorax*, being very nearly of the same magnitude.

Further examination shows a striking similarity between *Nycticorax* and the day herons, the only variation being in the relative size of the paired foramina. The largest paired openings occur in *Hydranassa tricolor*.

SUMMARY

Measurements from skeletal elements of two night herons, *Nycticorax nycticorax* and *Nyctanassa violacea*, are compared. Two statistical methods used to examine the differences between the two forms were the test of significance of difference by *t* values and the coefficient of divergence. The latter statistic was used to indicate the degree of sexual dimorphism.

Mean measurements of the male of *Nycticorax* exceed those of the female in all except the symsacrum width. In no case did the measurements of one sex exceed those of the other sex by more than 2.0 per cent. Mean measurements of the male of *Nyctanassa* exceed those of the female in 42 of the measurements taken. Each of the coefficients of divergence of the six measurements in which the female exceeds the male are less than 3.5 per cent.

The two genera differ significantly in 17 of the 47 measurements taken, irrespective of the sex. For comparisons of thirty-two measurements the *t* values are 3.0 or more, for six the *t* values are 2.0-2.9; remaining measurements do not differ significantly.

Nycticorax exceeds *Nyctanassa* in 33 and 35 measurements, for the males and females, respectively, while *Nyctanassa* exceeds *Nycticorax* in 8 and 10 measurements, for the males and females, respectively.

Of 18 ratios computed for various combinations of skeletal elements, only five are considered to be significant. These reflect throughout the differences in lengths of the leg bones of the two forms. There is no sexual dimorphism exhibited in the ratios.

Differences in structural form, those not easily expressed by measurements, also indicate distinctions between skeletal elements of the two genera. Four such differences are noted and are compared between night herons and other herons.

A great variation in the conformation of skeletal elements is found in the subfamily Ardeinae. It would be desirable to investigate the degree of correlation of the skeletal differences with differences in ecology and to compare other members of the family. In the meantime, the available evidence favors maintaining *Nycticorax* and *Nyctanassa* as separate genera.

University of Florida, Gainesville, Florida, September 17, 1954.

FROM FIELD AND STUDY

Foraging Behavior and Predation by Clark Nutcracker.—The Clark Nutcracker (*Nucifraga columbiana*) is abundant in the Teton and Absaroka mountains of northwestern Wyoming. During the summers of 1951 and 1952, support from the New York Zoological Society enabled me to make observations almost daily at the high elevations of these mountains during the months of June, July and August. Notes concerning the occurrence and activities of nutcrackers were made frequently.

Groups of two to six individuals were seen on several occasions foraging on the cliffs and on the talus slopes below the cliffs. The birds worked together, all progressing in the same direction and each at a different elevation on the cliff or slope. In this way they thoroughly inspected the entire area and then moved off together to another. The object of their intensive search was never clear although presumably they were foraging. Since this activity was observed chiefly during the early hours of the morning it seems possible that they found insects on the rocks which remained there chilled by the cold of the night. Minimum temperatures recorded during July were nearly always below 50°F. and occasionally as low as 38°F.

On July 26, 1951, a nutcracker observed at close range was systematically hiding small black objects, probably seeds, in the debris accumulated on small ledges of a cliff. The bird made a hole with its bill by a thrust or two of the head, regurgitated a small black object to the tip of the bill, thrust it into the hole, and placed a small stone over it. Food stored in such locations is available throughout the winter because snow accumulation on the small ledges is slight and melting rapid if the cliff receives the direct rays of the sun at some time during the day. Food storage seems to be a characteristic habit of members of this family of birds.

In northwestern Wyoming the nutcracker was the chief predator on the Black Rosy Finch, *Leucosicte atrata*. On August 3, 1951, from the top of a high cliff two rosy finches were observed on the talus below. They seemed to be chasing a nutcracker. Presently the nutcracker flew down beside a boulder, seized a rather large object in its bill and flew a short distance with it down the slope to a tree. He was followed by a rosy finch. When the nutcracker dropped the object, it fluttered to the ground, obviously a young bird and probably the young of the interested rosy finches. The nutcracker pursued the young bird into some shrubs while the adult rosy finch flew about excitedly. The young bird was not seen again. Later, when a nutcracker was in the vicinity of the slope, the rosy finches became excited, flying after it and uttering hoarse chirps. They perched near the nutcracker, chirping, or flew around it, but never did they attack the bird. When the nutcracker came too close, the rosy finches retreated. The larger bird never appeared disturbed or even concerned about the presence of the rosy finches. The nutcracker is three or four times the size of a rosy finch but the latter is more agile in the air.

Early on the morning of July 16, 1952, shortly after I arrived to observe a rosy finch nest, a nutcracker flew to the cliff and worked its way to the nest. The nest was situated in a small cavity, only slightly larger than the nest itself, on the face of the cliff about fifty feet from the base and approximately the same distance from the top. The nutcracker fluttered to the nest cavity, put its head in and came out with a white egg. The bird carried the egg to a grassy spot on the cliff and ate it. In the meantime the female rosy finch returned to the nest. The nutcracker again returned and as it flew to the nest the female rosy finch flew off. Another egg was removed while the rosy finches flew about protesting. The female rosy finch did not return to the nest between the taking of the second, third and fourth eggs. The third egg was dropped while being removed and the nutcracker flew after it to the snow below, where it was consumed. Later examination of the spot showed that nothing remained but a few fragments of the shell and a yellow spot on the snow. The entire process was completed in about twenty minutes. About ten minutes later the bird again returned to the nest and pulled it apart, letting the material fall to the base of the cliff. Another ten minutes passed before the female rosy finch returned to the nest site. She did not enter the cavity but stood beside it and looked in. Then she flew down to the nest material on the snow before flying away. A few minutes later she returned and went into the nest cavity, followed by the male. One of the birds was observed begging or displaying, the body held low and the wings fluttering. The rosy finches renested a few days later,

choosing another location on the same cliff perhaps one hundred yards from the site of the first nest. Three young disappeared from this nest shortly after hatching.

Under a slanting rock on the tundra at the top of the cliff was the nest of a Water Pipit (*Anthus spinoletta*) containing two young. Five days after the destruction of the rosy finch nest and eggs the young pipits were found dead. One was still in the nest, the other had been dragged over the edge. The bird in the nest had a single small wound in the back of the head, the other had a single bloody spot on the breast. This was presumed also to be the work of a nutcracker.—NORMAN R. FRENCH, *University of Utah, Salt Lake City, Utah, August 7, 1954.*

New Nesting Records from Boulder County, Colorado.—The Bush-tit (*Psaltirparus minimus*) is a common resident in the cedars and piñon pines of southern Colorado, but it has been observed only infrequently in the north-central part of the state. Jollie (Condor, 47, 1945:81-82) first described the occurrence of wintering Bush-tits in yellow pine forests near Boulder. From February to June, 1954, the writer saw several birds of this species in a foothills habitat about one-half mile south of Boulder. On June 12, in the same location, two parent birds were observed while feeding their young in a yellow pine near the eastern limits of this forest, at an elevation of 5800 feet. The pendant nest was constructed seven feet out on a limb, about thirty feet from the ground in a forty-five foot pine. The pair actively foraged in a large wooded area west of the home tree. On June 20, the nest was empty, and on June 26, the family of two adults and five young was seen in the forest nearby. A second brood was raised in the same nest; the young were being fed there on July 25, and a noisy family group was observed in the pines west of the empty nest on August 2.

Regarding the Golden-crowned Kinglet (*Regulus satrapa*), Niedrach and Rockwell (Birds of Denver and Mountain Parks, 1939:129) state: "Very little information relative to the occurrence of this species in the Denver area is available." During the winter of 1953-54, small flocks of Golden-crowned Kinglets were found in a foothills habitat of yellow pine forests and bushy gullies (elevation 5700-6200 feet) extending two miles south of Boulder, Colorado. One to ten birds were seen on each of several field trips from December 25, 1953, to April 18, 1954. A pair of Golden-crowned Kinglets was observed while feeding young in a nest in Boulder Canyon, one-fourth mile east of Tungsten, at an elevation of 8025 feet, on June 27, 1954. The nest was about twenty feet from the ground, three feet out on a limb of a thirty-five-foot Engelmann spruce. Two other birds of this species were heard in a dense stand of large Engelmann and blue spruces several hundred yards east of this location and were believed to be nesting males.

Regarding the Indigo Bunting (*Passerina cyanea*), Niedrach and Rockwell (*op. cit.*:151), suggest that "this species may be a rare breeder" near Golden, Colorado. During June and July, 1954, a male Indigo Bunting was observed several times in a bushy ravine (elevation 5700 feet) just south of Boulder. The male sang repeatedly from a regular perch, and it was assumed to be nesting.—LOUISE HERING, *Boulder, Colorado, August 10, 1954.*

Frigate Birds Crossing the Isthmus of Tehuantepec.—In a note by Walter W. Dalquest (Condor, 53, 1951:256), it is suggested that Frigate Birds may fly regularly overland from one ocean to the other. This is quite possible since on August 12, 1954, at about noon I was at the Zoological Park in the outskirts of Tuxtla Gutiérrez, in northwestern Chiapas, and saw two adult Frigate Birds (*Fregata magnificens*), male and female, flying overhead. The grounds at our zoo are open fields and I had a clear view of the birds when they approached from the north. The birds were somewhat low and sailing at moderate speed, and after circling twice over the town, they took altitude and headed purposefully due southwest. The day was bright and there was a moderate wind from the northwest.—MIGUEL ALVAREZ DEL TORO, *Instituto Zoológico, Tuxtla Gutiérrez, Chiapas, México, August 10, 1954.*

Record of the Least Flycatcher in Central British Columbia.—Munro and Cowan (A Review of the Bird Fauna of British Columbia, 1947:150) record the Least Flycatcher (*Empidonax minimus*) in British Columbia only from the northeastern section, principally in the Peace River parklands. On June 2, 1934, I took a specimen of this species at Indianpoint Lake in the Cariboo District of the central interior of the province. It was a male with testes measuring 5 mm. and was singing continually, giving a raspy *che-bek* note. This note seemed different from the notes of the

Wright and Hammond flycatchers with which I was familiar and which occur in the Cariboo District. The bird was located in alders and willows over swampy ground at the inlet to the lake, a habitat normal for the breeding season in this species. These circumstances strongly suggest that it was stationed for nesting.

The identity of the bird was not clear to me at the time it was taken and I am indebted to Allan R. Phillips for aid in subsequent proper determination of it as well as to J. A. Munro for pointing out the significance of this record from west of the Rocky Mountains.—ALDEN H. MILLER, *Museum of Vertebrate Zoology, Berkeley, California, May 10, 1954.*

Albino Swallow in Sequoia National Park.—An albino swallow was observed on August 4, 1954, near the Wolverton Ski Hut in Sequoia National Park, California. A group of forty-five park visitors watched the white bird sweeping through the air capturing insects for more than twenty minutes. On occasion when the bird wheeled and turned within ten feet of us, we could see that its entire plumage was white and the eyes pink. It was flying in company with a large flock of normally colored Violet-green Swallows (*Tachycineta thalassina*) and we assumed it was of the same species as it appeared to be of the same size and shape. Also, no other species of swallow was noted in the area that morning. On August 11, 1954, Violet-green Swallows were again observed at Long Meadow, but the albino bird was not seen that day. Three days later, however, three park visitors who had just returned from a hike to Heather Lake reported they had observed a white swallow flying above Tokopah Valley in the vicinity of The Watchtower, at an altitude of 8600 feet. This could have been the same bird observed at Long Meadow on August 4, or another one.

Although albinism reasonably may be expected in any species, its occurrence in swallows seems sufficiently unusual to be noteworthy.—JACK C. VON BLOEKER, JR., *Giant Forest, Sequoia National Park, California, September 1, 1954.*

Additional Records of Emperor Goose from California.—On December 1, 1935, I received two male Emperor Geese (*Philacte canagica*) from the Gustine Gun Club to be mounted. These birds had been shot the same day approximately four miles southeast of Gustine, Merced County, California, by W. Evans of Salinas, a member of the club. The two geese had been sitting together in the marsh and were not associated with other geese. Upon being frightened, they had flown off "... cackling with every flap of their wings," according to George W. Fink of Crows Landing, who had flushed them. One of the geese weighed four pounds while the other weighed three pounds 15 ounces. The fact that these weights are considerably below the mean weight of 6.1 pounds listed by Kortright (*The Ducks, Geese and Swans of North America, 1943:382*) for seven males of this species, may be a reflection of their poor condition due to wandering far from their customary range and habitat. The mounted skins of these geese are still in existence at the Clubhouse near Gustine.

In correspondence with George Fink concerning these birds, I learned that two other Emperor Geese were taken on the same day at the Modesto Properties Gun Club, ten miles south of Turlock, a locality also within Merced County. The skin of the male was retained by Hugh P. Walls, of Sacramento, for several years, and subsequently lost. No weights are available for these geese, but they, too, are reported to have been apart from other species of geese at the time they were taken. The possibility that these geese had wandered from their normal range in company with the Gustine birds is suggested.

The only previous record as far south as Merced County in interior California was listed for Ingomar in "December of 1912" (Grinnell and Miller, *Pac. Coast Avif. No. 27, 1944:70*). Ingomar is a small settlement situated less than a mile and a half to the southwest of the southern boundary of the 2200 acre Gustine Gun Club. No Emperor Geese have been reported at this locality during the intervening nineteen years.—RICHARD E. GENELLY, *Department of Zoology, University of California, Davis, California, September 8, 1954.*

NOTES AND NEWS

The Twenty-fifth Annual Meeting of the Cooper Ornithological Society is scheduled for April 21 to 23, 1955, at Asilomar, Pacific Grove, California. The Committee on Arrangements appointed by the Board of Directors is as follows: Mr. and Mrs. Charles H. Anderson, E. Laurence Curl, W. I. Follett, Elmer E. Highley, Junea W. Kelly, Eric C. Kinsey, Ken Legg, T. Eric Reynolds, Robert K. Selander, Laidlaw O. Williams, and John Davis, *Chairman*.

The color plate in this issue shows a group of Central American tanagers drawn by Don R. Eckelberry. It was first reproduced as the frontispiece of Alexander F. Skutch's *Life Histories of Central American Birds*, Pacific Coast Avifauna number 31, in March, 1954.

We learn with regret of the death of Arthur Cleveland Bent on December 30, 1954. Some years ago Mr. Bent arranged with James Lee Peters, at that time President of the Nuttall Ornithological Club, to have that organization sponsor preparation of the remaining *Life Histories* should such action prove necessary. More recently, Mr. Bent had the Club appoint Wendell Taber as Chairman of a committee to carry out that task, and in May, 1954, he turned his work over to the committee. Members in addition to the Chairman are: Mrs. A. C. Bent, Alfred O. Gross, William G. F. Harris, Frederick C. Lincoln, Robert A. Norris, Christopher M. Packard, and Lawrence H. Walkinshaw. Contributions of material and photographs will be welcome as before and may be sent to the most convenient member of the committee. It is hoped the volume on the Icteridae will go to the printer in the spring of 1955. Preparation of manuscripts for the first of the three volumes on the Fringillidae, extending up to the towhees, is far advanced. No change in format is planned.

In conjunction with part 4 of James P. Chapin's "Birds of the Belgian Congo" there appeared a *Gazetteer* for the birds of the area. This *Gazetteer*, of about 100 pages, is available as a separate in protective paper covers from the Department of Birds at the American Museum of Natural History, New York City; cost \$1.00.

COOPER SOCIETY MEETINGS

SOUTHERN DIVISION

OCTOBER.—The monthly meeting of the Southern Division was held on October 26, 1954, at the Los Angeles County Museum. The following names were proposed for membership: Martin D. Brown, 11319 S. Fidel Ave., Whittier, Calif., by M. Dale Avery; Frederick Graham Cooch, Dept. Conservation, Cornell University, Ithaca, N.Y., by C. G. Sibley; Edward Lloyd Webb, 254 E. 2nd St., Mesa, Arizona, by John T. Wright; Johnny Wiens, 428 Chatauqua, Norman, Oklahoma, and Fred C. Zwickel, Rt. 4, Box 4113, Highland Ave., Wenatchee, Wash., by J. C. von Bloeker, Jr.; Leon Moses, M.D., 19 E. 74th St., New York 21, N.Y., Chandler S. Robbins, Rt. 1, Box 323-A, Laurel, Maryland, G. Bernard Van Cleve, 323 S. Fairmount St., Pittsburgh 32, Pa., and Dr. Warren S. Wooster, Scripps Institution of Oceanography, La Jolla, Calif., by C. V. Duff.

Dr. George A. Bartholomew, Jr., of the Zoology Department of the University of California at Los Angeles, spoke on "Wildlife of Arid Australia."—DOROTHY E. GRONER, *Secretary*.

NORTHERN DIVISION

OCTOBER.—The monthly meeting of the Northern Division was held on October 7, 1954, in Life Sciences Building, University of California, Berkeley. The following names were read for membership: Major Francis O. Chapelle, U.S. Army Hospital, Ft. Clayton, Canal Zone, by Frank A. Pitelka; James L. Amero, 2905 SW 1st Ave., Portland 1, Ore., by Richard F. Johnston; and Miss Joan Malloy, Department of Zoology, University of California, Berkeley 4, Calif., proposed by Thomas R. Howell.

A. Laurence Curl recorded a Lewis Woodpecker on September 16 and a White-breasted Nuthatch on September 18 at El Cerrito, California. Loye Miller called attention to Tinbergen's new book, "The Herring Gull's World." He also described the behavior of a pair of Bewick Wrens, which entered a cabin in Lake County by flying under the door to reach their nest within. Later they continued to fly under an imaginary door after the door had been opened.

The speaker, Mrs. Junea W. Kelly, made "A Comparison of Some Birds of Central Europe and California."—ROBERT K. SELANDER, *Secretary*.

For Sale, Exchange, and Want Column—Each member of the Cooper Society is entitled to one short advertising notice in any issue of the Condor free. Notices of over 3 lines will be charged for at the rate of 25 cents per line. Send advertising copy to Jack C. von Bloeker, Jr., 161 West 121st St., Los Angeles 61, California.

FOR SALE—Dawson, *Birds of California* (Patron's Ed.), 4 vols. octavo, unused and in perfect condition; Dawson and Bowles, *Birds of Washington* (Patron's Ed.), 2 vols., completely leather-bound, the same as new, rare. Make me an offer for either or both of these very fine books.—W. LEE CHAMBERS, R. R. 1, Box 294, Topanga, Calif.

FOR SALE—Books from the library of the late Dr. Walter K. Fisher, including many fine items such as: Bent, *Life Histories N. A. Birds*; Ridgway, *Birds of North and Middle America*; Loomis, Calif. Water Birds, pts. 1-3 (rare); Grinnell, Bryant, Storer, *Game Birds Calif.*; No. Am. Fauna series; rare separates by Ridgway, Bendire, etc. Inquiries invited.—MRS. ANNE B. FISHER, Box 239, Pacific Grove, Calif.

FOR EXCHANGE OR SALE—Bent, *Diving Birds*, \$27.50; Gulls, Terns, \$10.00; *Birds of Prey*, pt. 2, \$6.00; Nuthatches, Wrens, *et al*, \$3.50; Wagtails, Shrikes, *et al*, \$3.50; all originals in fine condition, orig. wrappers, pages uncut. Prefer to exchange these and some additional ornithological separates for a good second-hand 35 mm. single lens reflex camera, but will sell at the prices indicated, if necessary.—HAROLD A. DUNDEE, *Museum of Zoology, Univ. Michigan, Ann Arbor, Mich.*

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January 1, 1955

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